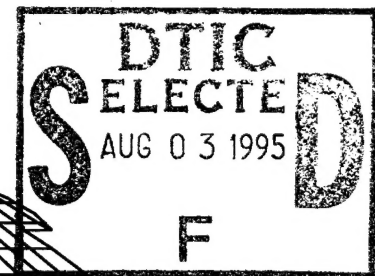
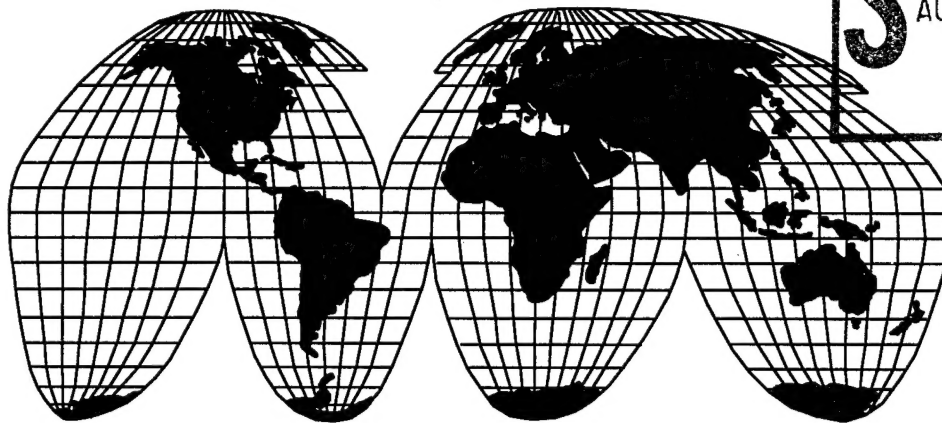




# World-Wide Conventional Arms Trade (1994-2000)

## A Forecast and Analysis



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## Preface

*The conventional arms market has changed substantially since the end of the Cold War. In this new environment, U.S. conventional arms transfer policy decisions will still continue to be guided predominantly by national security and foreign policy criteria. However, the new environment has also created pressures for the U.S. to give more consideration to economic security factors when making decisions about possible conventional arms transfers.*

*Therefore, the Office of the Under Secretary of Defense (Acquisition and Technology) conducted this study to provide an analytical basis for conventional arms transfer decisions. Other organizations participating in this study included the Department of Commerce, the Defense Security Assistance Agency, and other U.S. government components.*

*This study was directed by Dr. Kenneth Flamm, Principal Deputy Assistant Secretary of Defense for Dual Use Technology Policy and International Programs. Participants contributing to the study report were John Babey, Lyndall Beamer, John Caves, Dan Dennison, Robert Dunn, Bob Fitton, John Hill, Jay Mandelbaum, Dan McMahon, Tom Meeker, Lawrence Schwartz, Maggie Smith, Earl Wingrove III, and John Zavales. Data in the report are accurate as of July, 1994.*

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## Executive Summary

The end of the Cold War has had a major impact on global trade in conventional armaments, just as it has on most facets of national security and defense. The nature of global demand for arms has shifted from the context of rivalry between superpowers and their associated client states to providing for national defense within the context of regional security needs. While these changes have led to a decline in total global demand for arms, countries continue to seek to acquire substantial amounts of increasingly sophisticated weapons. Ironically, in many respects, the post-Cold War world is more unstable than the Cold War era, and is characterized by increased violence, by increased proliferation of military technology, and by the potential for these trends to continue. In this context, while the nature of the political-military issues that the U.S. and friendly nations now confront has changed, arms exports will continue to be a means of advancing U.S. national security and foreign policy objectives.

In addition to these political-military changes, the post-Cold War era has witnessed significant economic changes for the U.S. defense industry, as DoD purchases have sharply declined. Many U.S. defense companies have found that arms exports are an increasingly important component of their total sales and overall financial health. Therefore, some have suggested that arms transfer policy decisions should also take into account the possible impacts of export sales on the ability of industry to support national defense requirements. This has led to various proposals to increase the level and kinds of support that the U.S. government provides to U.S. companies when competing for approved international arms sales.

In light of these changes, the objectives of the study are to:

- (1) develop a forecast of world-wide arms trade deliveries for the remainder of the decade, absent major changes in nations' broad arms export policies or in the global security environment;
- (2) determine the likely bounds of the U.S. share of that market; and
- (3) explore defense industrial and economic aspects of arms sales.

Six significant factors have been identified as driving the changes in the international arms market.

- (1) Changing threat perception. Elimination of tensions between NATO Allies and the former Warsaw Pact countries significantly reduced global threat perceptions starting in the late 1980s. While the end of hostile military intentions by the former Soviet Union has greatly eased some of the major tensions in the world, the demand for advanced military hardware and related arms imports has not abated everywhere. Some of the drivers for this demand include regional tensions, such as the Korean Peninsula and the Middle East and competitions for contested economic zones such as the Spratly Islands.

- (2) Drastic reduction in grant aid. During the 1988-93 period, Soviet and Russian grant aid deliveries fell from \$9 billion to \$100 million (1991 constant dollars). In the case of the U.S., grant aid declined significantly. In total, discretionary grant aid (not directed by law to Egypt or Israel) dropped from \$3.2 billion in 1984, to under \$700 million in FY 1989, to less than \$34 million in FY 1993.
- (3) Financing difficulties. In the post-Cold War era, many Western governments are reducing defense budgets and are redirecting their resources into improvements in domestic economic infrastructure. Also, many developing countries, with the exception of some oil rich states and wealthy Far East nations, lack large cash reserves and are dependent on securing some financial concessions from sellers in order to purchase arms. In certain instances, suppliers are increasingly reluctant to make military sales to countries that lack either cash reserves or good credit ratings.
- (4) Emphasis on upgrades. This factor is closely associated with a nation's financial situation. In a resource constrained environment, many nations are turning to upgrades to improve the capabilities of existing military systems at the lowest possible cost and to perform mid-life modernization of major weapons. Upgrades of tanks and fighter aircraft, for example, generally cost one-fourth the price of new systems, making upgrades an attractive option for nations trying to lower defense expenditures.
- (5) Increased demands for advanced munitions and electronics. Air forces are increasingly viewing standoff precision weapons as a cost-effective way to destroy targets while reducing losses and using fewer aircraft. Additionally, advanced munitions potentially offer logistics savings by reducing the need to carry out operations of extended duration. Both the importance of electronic warfare and the demand for such equipment are expected to increase. Most armed forces are becoming increasingly dependent on electronics for command, control, communication, and intelligence (C3I), and for surveillance and fire control. Many modern weapons, including air-to-air and surface-to-air missiles, employ radar and other electromagnetic sensors or command guidance links.
- (6) Increased buyer leverage and competition. The downsizing of the international arms markets and the general decrease in defense spending by arms exporting nations, has led to intense competition for arms sales. Suppliers are competing for fewer and generally smaller sales. These fewer and smaller sales are more important to the financial viability of supplier companies as their business base declines. Within this tight competitive environment, customers are demanding and obtaining significant concessions from suppliers. Financial problems in the customer countries may also aggravate the situation.



All of these factors have already affected the world-wide defense arms market. During the 1981-1988 Cold War period, world-wide arms deliveries averaged about \$66 billion annually in 1991 constant dollars. The U.S. share of that market averaged slightly more than 20 percent. In the immediate post-Cold War period, from 1989 through 1991, the size of the global defense export market fell by more than one-third to an annual average of \$40 billion. The U.S. share of these immediate post-Cold War deliveries averaged just above 30 percent. In 1992 and 1993, world-wide defense deliveries dropped almost an additional 50 percent to an annual average of \$21 billion, while the U.S. share increased to more than 50 percent of the market, making the U.S. defense industry the world's pre-eminent military equipment supplier. Over the entire 1981-1993 time frame, U.S. arms deliveries declined by less than 25 percent, from approximately \$13 billion per year to between \$10 and \$11 billion annually. The total market declined much more precipitously, by about 70 percent.

These factors will continue to affect the defense arms market in the future. Arms delivery forecasts were constructed for 37 selected countries and major categories of military items for the period 1994 through 2000. These countries account for approximately 86 percent of all defense imports, and referenced weapon systems represent about 90 percent of the dollar value of global defense trade. The forecasts were based on assessments of future weapon requirements for the selected countries and the most likely way in which these requirements would be met considering such factors as affordability, threat perceptions, national priorities, indigenous production capability, and political acceptability of suppliers.

While arms trade deliveries are projected through the end of this decade relative to the 1991-93 levels, arms trade volume in the 1990s will remain far below the level of the 1980s. The total global arms trade from 1991 through 2000 is projected to range between \$291 billion and \$330 billion in 1991 constant dollars. This represents a 47 to 53 percent reduction from the \$625 billion of total arms exports in the 1981-1990 period. Given the trade data through 1993, the actual value will probably be closer to the lower end of the range.

The forecasts support a continuing strong defense trade performance for U.S. defense products through the end of the decade and beyond. In a large number of cases, the U.S. is clearly the preferred provider, and there is little meaningful competition with suppliers from other countries. An increase in the level of support the U.S. government currently provides for arms exports is unlikely to shift the U.S. export market share outside a range of from 53 to 59 percent of world-wide arms trade. Only changes in the basis for governmental decisions regarding the approval of U.S. arms exports would likely move the U.S. share outside this range. If future deliveries not yet under contract resemble future deliveries already under contract (about half of future deliveries), changes in the level of support that the U.S. provides for arms exports would be unlikely to shift the U.S. market share outside a much narrower 58 to 59 percent range.

There are a number of reasons for this continued U.S. pre-eminence. In markets where U.S. products compete, U.S. sales will remain strong because:

- (1) many countries seek interoperability with the U.S.;

- (2) U.S. products are top of the line -- Desert Storm illustrated battle proven superiority;
- (3) the U.S. continues to perform the research and development necessary to maintain superiority;
- (4) U.S. prices are competitive;
- (5) the U.S. provides outstanding service after the sale, including training support; and
- (6) the U.S. has built long-standing buyer-seller relationships.

Nevertheless, the potential impacts of marginal changes in U.S. arms exports should not be overlooked. Arms exports by U.S. firms have not declined in proportion to U.S. defense procurement outlays, and exports now account for an increasing percentage of U.S. produced defense equipment sales. U.S. arms exports in the 19 years from 1971 through 1989, had an average annual value of \$13 billion in 1991 dollars. Since 1989, exports have averaged \$10 billion annually. Based on the forecasts for the remainder of this decade, average annual arms exports might be expected to rise to as much as \$16 billion. The ratio of exports to procurement outlays averaged nearly 15 percent from 1984 to 1991, and may have recently begun an upward trend.

In some particular cases, arms exports can have an important effect on the resources that DoD expends to support and equip our armed forces. Examples of specific areas where increased arms exports have had important effects on the defense industrial infrastructure include the tank and helicopter sectors. Foreign sales created sufficient demand in these sectors to expand available options for meeting DoD requirements.

The study concludes that, in addition to the primary considerations concerning national security and foreign policy factors, there is room at a secondary level within a conventional arms transfer policy for defense industrial and economic concerns.

## Table of Contents

1. Introduction .....	1
2. The Conventional Arms Trade Environment Through the Year 2000.....	5
2.1 Introduction .....	5
2.2 Changing Threat Perceptions .....	6
Table 2.1 - Total Soviet / Russian Arms Deliveries (1988-93) .....	6
2.3 Drastic Reduction In Military Grant Aid .....	7
Table 2.2 - Total Soviet / Russian Grant Aid Arms Deliveries (1988-93) .....	8
Table 2.3 - U.S. Grant Military Aid: FY 1989 and FY 1993 .....	8
2.4 Increased Concerns About Price and an Emphasis on System Upgrades .....	9
2.5 Increased Demands for Advanced Munitions and Electronics .....	10
2.6 Increased Buyer Leverage and Market Competition .....	12
3. Requirements Driven Commodity Forecasts .....	15
3.1 Forecast Approach .....	15
Figure 3.1 - Arms Trade Database Countries .....	16
Figure 3.2 - Arms Trade Database Categories .....	17
3.2 Overall Arms Trade in the 1990s .....	18
Figure 3.3 - Arms Imports by Region (1981-1990) .....	18
3.3 Aggregate Demand by Region.....	19
Figure 3.4 - Projected World-Wide Demand by Region (1994-2000) .....	20
3.3.1 Middle East Demand.....	20
Figure 3.5 - Middle East Region .....	20
Figure 3.6 - Projected Middle East Demand by Country (1994-2000) .....	21
3.3.2 East Asia, South Asia, and Oceania Demand .....	22
Figure 3.7 - East Asia, South Asia, and Oceania Regions.....	23
Figure 3.8 - Projected East Asia, South Asia, and Oceania Demand by Country (1994-2000) .....	23
3.3.3 Europe Demand .....	24
Figure 3.9 - Europe Region.....	25
Figure 3.10 - Projected Europe Demand by Country (1994-2000) .....	25
3.3.4 Africa and Latin America Demand .....	26
Figure 3.11 - Africa and Latin America Regions .....	27
Figure 3.12 - Projected Africa and Latin America Demand by Country (1994-2000) .....	27
3.4 Supplier Profiles.....	28
Table 3.1 - Top Six Arms Supplier Countries (1992-93) .....	28
3.5 Commodity Forecast Results.....	31
Figure 3.13 - Forecasted Arms Trade Deliveries (1994-2000).....	32
Figure 3.14 - Supplier Market Share of Total World-Wide Arms Deliveries (1994-2000).....	33
3.5.1 Aircraft Forecast .....	34
Figure 3.15 - Supplier Market Share of World-Wide Aircraft Deliveries (1994-2000) .....	34
3.5.2 Helicopter Forecast .....	35
Figure 3.16 - Supplier Market Share of World-Wide Helicopter Deliveries (1994-2000) .....	36
3.5.3 Vehicle Forecast.....	37
Figure 3.17 - Supplier Market Share of World-Wide Vehicle Deliveries (1994-2000) .....	37
3.5.4 Ship Forecast.....	38
Figure 3.18 - Supplier Market Share of World-Wide Ship Deliveries (1994-2000) .....	39
3.5.5 Artillery Forecast .....	40
Figure 3.19 - Supplier Market Share of World-Wide Artillery Deliveries (1994-2000) .....	40
3.5.6 Missile Forecast .....	41
Figure 3.20 - Supplier Market Share of World-Wide Missile Deliveries (1994-2000) .....	42
3.5.7 C3I Forecast .....	42
Figure 3.21 - Supplier Market Share of World-Wide C3I Deliveries (1994-2000).....	43

4. Future U.S. Export Performance and Potential Impacts of Arms Trade Policies .....	45
4.1 U.S. Market Share of World-Wide Arms Trade.....	45
Figure 4.1 - U.S. Share of World-Wide Arms Trade Deliveries (1981-1993) .....	45
Figure 4.2 - Bounds on U.S. Arms Exports (1994-2000).....	48
Figure 4.3 - Competitive Arms Market by Commodity (1994-2000).....	49
Figure 4.4 - Competitive Arms Market by Demand Region (1994-2000).....	50
4.2 Factors Contributing to the Continued Market Strength of U.S. Arms Exports .....	51
5. Conventional Arms Transfer Policy and Defense Industrial and Economic Concerns .....	53
5.1 National Security, Industrial Infrastructure and Arms Exports .....	53
5.2 Examples of Key Contributions of Arms Trade to the Industrial Base .....	55
Figure 5.1 - DoD Procurement Outlays (1970-1999).....	56
Figure 5.2 - U.S. Arms Export Deliveries (1971-1993).....	56
Figure 5.3 - Ratio of U.S. Arms Exports to DoD Procurement Outlays (1971-1993).....	57
Figure 5.4 - Abrams Tank Production.....	59
5.3 Conclusions .....	60
Appendix A. Econometric Analysis.....	A-2
A.1 Econometric Arms Trade Relationships .....	A-2
Table A.1 - Average Econometric Estimating Error Rates.....	A-4
Figure A.1 - World-Wide Arms Imports (1982-91): Actual vs Estimated .....	A-5
A.2 Econometric Arms Trade Projections.....	A-5
Figure A.2 - Econometric Bounds on Middle East Arms Imports (1994-2000) .....	A-6
Figure A.3 - Econometric Bounds on East Asia Arms Imports (1994-2000).....	A-7
Figure A.4 - Econometric Bounds on Rest of the World Arms Imports (1994-2000) .....	A-8
Figure A.5 - Econometric Bounds on World-Wide Arms Imports (1994-2000).....	A-8
A.3 Summary and Conclusions .....	A-9

# 1. Introduction

The end of the Cold War has had a major impact on the trade in conventional armaments, just as it has on most facets of national security and defense. During the Cold War, the Soviet Union was the world's largest exporter of military products. These exports were an important means through which the Soviet Union sought to spread its influence. The conventional arms transfer policies and other national security policies of the U.S. and its allies were driven in large part by the need to confront the aggressive Soviet posture. U.S. defense exports were principally geared to countering the military influence of the Soviet Union and its allies. With large domestic military acquisition budgets, defense exports were not viewed as a key component of the financial viability of U.S. defense suppliers, or as integral to the preservation of essential industrial or technological capabilities.

Today, national security policy decisions, including conventional arms transfer policy decisions, are driven to a large extent by regional security factors which have replaced the dynamic of global superpower competition. This has led to sharp reductions in DoD budgets for the acquisition of new weapon systems, but has not sharply reduced global demand for U.S. weapons. While the demise of the Soviet Union has removed the largest threat against U.S. interests at home, in many areas of the world it has allowed long-suppressed regional frictions to resurface. In this environment, U.S. friends and allies still have very legitimate armaments acquisition needs. The dynamics of today's conventional arms market clearly reflect these factors.

- Russian conventional arms exports are an order of magnitude smaller than they were during the Cold War. From 1981 through 1990, Soviet arms exports totaled nearly \$240 billion in 1991 dollars -- about 38 percent of the world-wide arms delivery total of \$625 billion. From this \$24 billion annual average, Russian arms exports fell to \$6.6 billion in 1991 and to \$2.6 billion in 1993. Much of this decline is attributable to the virtual end of Russia's military grant aid programs.<sup>1</sup>
- The overall value of the arms trade in the 1990s is expected to be smaller than its value in the 1980s. Over the 1981-93 time frame, world-wide arms exports declined by approximately 70 percent -- from \$67 billion to \$20 billion in 1991 dollars.
- As Russia and other countries have seen their markets decline or collapse, demand for U.S. arms has remained firm. This has made the U.S. the world's largest arms exporter by a significant margin. In 1993, the \$10.8 billion of U.S. arms exports accounted for more than 50 percent of world-wide arms deliveries in 1991 dollars.

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<sup>1</sup> In this study, figures on arms exports refer to deliveries rather than sales agreements, except where otherwise indicated. This is not the normal practice in arms market studies. However, deliveries provide a more precise basis for assessing the impacts of arms exports on the producer industries over any given time period, which is the focus of this study.

The UK, with over \$4 billion in 1993 deliveries and a market share of 20 percent, was the second largest exporter. Russia's \$2.5 billion in global sales made it the third largest exporter, with a 12 percent market share. The shrinking market has intensified competition for the remaining market opportunities.

- U.S. defense industry is maintaining that increased arms sales are an important component of its financial viability. Defense budgets have fallen sharply and continue to decline. Procurement outlays have dropped, in constant 1991 dollars, from a high of \$94.1 billion in FY 1987 to \$66.1 billion in 1993. Exports have become a larger proportion of sales and, consequently, are now more important to many sectors.
- In certain instances, arms exports may affect the cost of DoD weapon procurements. The unit price that DoD pays for military hardware is in part a function of the quantity of that hardware manufactured. Quantities being bought by the U.S. military have in many cases been reduced. Therefore, the ability of contractors to gain larger production runs and other economies of scale through foreign sales may become increasingly important.

In this new environment, U.S. conventional arms transfer policy decisions will continue to be guided by national security and foreign policy criteria. However, arms transfers could make important contributions to ensuring DoD's continued access to essential industrial and technological capabilities.

Accordingly, the study objectives are to:

- (1) develop a forecast of world-wide arms trade deliveries for the remainder of the decade absent major changes in nations' broad arms export policies or in the global security environment;
- (2) determine the likely bounds of the U.S. share of that market; and
- (3) explore defense industrial and economic aspects of arms sales

The remainder of this report is organized around these objectives. The forecast of world-wide arms trade for the remainder of the decade is developed in Chapters 2 and 3.

Chapter 2 describes the overall arms trade environment. It provides a baseline description of those factors that define the arms trade environment of the 1990s from both government and industry viewpoints.

Chapter 3 contains requirements-driven forecasts for the 1994-2000 time period<sup>2</sup>. After describing the forecast approach, the discussion characterizes the major world arms markets in

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<sup>2</sup> Appendix A contains an econometric forecast of defense trade through the year 2000. It describes an econometric model to explain defense trade relationships and uses the model to make forecasts for 1994-2000.

terms of the principal buyers and sellers. Section 3.5 contains the forecasts for categories of weapon systems. Forecasts were made for seven aggregated systems groups, roughly associated with industrial sectors -- aircraft, helicopters, ships, vehicles, missiles, artillery, and C3I systems, taking into account new systems procurements and systems upgrades.

The determination of the probable bounds on the U.S. share of the forecast -- the second objective -- is made in Chapter 4. This chapter summarizes the numerical findings from Chapters 2 and 3 and shows how changes in the general level of support that the U.S. government provides to arms exports, within the current overall policy framework, are likely only to lead to marginal changes in a dominant U.S. market share.

Chapter 5 explores defense economic and industrial considerations -- the third objective of this study. It examines how certain sales opportunities may expand the range of options available to DoD for addressing defense industrial and economic concerns.

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Unfortunately, large differences between the upper and lower bounds of the forecast limited the usefulness of the results in accomplishing the objectives of this study. The effects of the end of the Cold War on the historical data greatly overshadowed the influences of other factors.



## 2. The Conventional Arms Trade Environment Through the Year 2000

*This chapter sets the stage for the development of arms trade forecasts. It provides qualitative descriptions of the factors that will dominate the arms trade environment for the rest of the decade.*

### 2.1 Introduction

From 1981 through 1988, world-wide arms trade deliveries averaged \$66 billion annually in constant 1991 dollars. Fluctuations from this average were small -- 1984 showed the greatest deviation with sales of \$73 billion. In contrast, 1988 was the first year of a six year decreasing trend. While total world-wide deliveries in 1987 were \$69 billion, they fell to \$20 billion in 1993. This decrease represents approximately a 70 percent drop in total deliveries, or a nearly 20 percent average annual decline. Five significant trends, discussed in the next five sections, have been identified as explanations of this changed behavior in the international arms market:

- (1) Changing threat perceptions;
- (2) Drastic reductions in military grant aid;
- (3) Increased concerns about the price of new weapon platforms and an emphasis on systems upgrades;
- (4) Increased demand for advanced munitions and electronics; and
- (5) Increased buyer leverage and market competition.

The discussions of these trends assume that the overall security environment in the world today will continue throughout the decade. A wide variety of alternative future scenarios could be constructed. While not necessarily likely, some of these alternatives offer the potential for significant changes in the level of arms trade. For example, nations will usually buy more arms as the perceived threat to their sovereignty increases. In this area, two scenarios for change in arms trade would be (1) if Russia were to reassume an aggressive military posture or (2) if sales of advanced weaponry at inexpensive prices were to generate a massive regional arms race. Alternative future economic scenarios offer a somewhat smaller potential to affect arms sales in the future. For example, changes to the price of oil could affect the purchasing power of large Middle East and Far East buyers. Another possibility is the potential rapid deterioration of the North Korean economy, reducing threat perceptions in that area of the world.

## 2.2 Changing Threat Perceptions

Reduction of tensions between NATO and the former Warsaw Pact significantly reduced global threat perceptions starting in the late 1980s. Prior to that time, during an era lasting more than four decades, the power struggle between the two military superpowers provided a continuing stimulus to both large and small nations to develop or acquire conventional arms either in the international arms markets or through Western and former Soviet Union sponsored military aid programs.

This decline is best illustrated by drops in Soviet / Russian arms deliveries as shown in Table 2.1 below:

<b>Table 2.1 - Total Soviet / Russian Arms Deliveries (1988-93)</b> (billion constant 1991 dollars)					
<u><b>1988</b></u>	<u><b>1989</b></u>	<u><b>1990</b></u>	<u><b>1991</b></u>	<u><b>1992</b></u>	<u><b>1993</b></u>
\$25.7	\$21.5	\$16.1	\$6.6	\$2.3	\$2.6

While the end of a great threat of hostile military action by the former Soviet Union has eased some of the major tensions in the world, the demand for advanced military hardware and related arms exports has not ended. There are several drivers of this demand, including:

- Currently, North Korea is probably the most significant military threat to the present strategic balance. Therefore security needs in East Asia stemming from the uncertain intentions of the large North Korean military affect demand in the region.
- The possibility of high profile aggression by Iraq and Iran continues to create instability in the Middle East region.
- Since the end of the Cold War, deep seated ethnic rivalries, territorial claims, and other disputes have come to the forefront in many developing world areas:
  - Border disputes between India and Pakistan.
  - Conflicts in the Balkans.
  - Tensions in the Middle East.

- Multiple East Asian claims to contested economic zones like the Spratly Islands and continuing interest in protecting sea lines of communication like the Malacca Straits.
- The rise of Muslim fundamentalism in the Mahgreb region of North Africa.

Such situations are likely to become more prevalent, thereby increasing demand for both high and low technology arms sales across the board.

In many cases, the demand will be for less than state-of-the-art systems such as anti-tank weapons, assault rifles, and artillery that are extensively produced in nations around the world. Smaller scale regional rivalries will provide a ready market for low and mid-tech equipment made by numerous less industrialized countries. These regional conflicts will also provide markets for some less sophisticated weapons produced by the former Soviet Union and China. According to the U.S. Congress' Office of Technology Assessment, about 40 developing countries produce some weaponry, with one quarter possessing significant military-industrial infrastructure<sup>3</sup>. While much of the military hardware produced is not of high quality, there has been a trend towards more capable equipment. In 1960, fewer than five major conventional weapon systems were licensed for production in the developing world; during the 1980s this figure increased to more than 90 systems.

On the other hand, a dynamic, growing economy in East Asia has provided several governments with the resources to increase investments in state-of-the-art military capabilities. While most other regions are reducing military expenditures and slowing the development of new weapons, many East Asian countries, driven by long standing rivalries among neighbors, are increasing military spending and developing domestic arms industries with particular emphasis on technology imports. Similar factors apply to the Middle East.

## 2.3 Drastic Reduction In Military Grant Aid

During the period 1986-92, Soviet and Russian arms transfer agreements with the developing world, funded in part with grant aid, ranged from \$19.7 billion in 1986 to a low of \$1.5 billion in 1992, in 1991 constant dollars. Each year during this period Russian arms transfer totals declined from those of the previous year. Motivated by Cold War considerations, the former Soviet Union maintained long-standing supplier relationships with many arms importers in the developing world. Because of domestic economic problems experienced in recent years, as well as the end of the Cold War, Russia has terminated its grant military assistance program with most countries.

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<sup>3</sup> "Global Arms Trade: Commerce in Advanced Military Technology and Weapons," Office of Technology Assessment Report Brief, June 1991.

The drop in arms deliveries is even more dramatic. By 1992, former Soviet Union grant aid shipments to such clients as Afghanistan, Cambodia, Ethiopia, Tanzania, Cuba, Mozambique, Yemen, and Vietnam were effectively eliminated. Table 2.2 shows Russian and former Soviet Union military grant aid deliveries.

**Table 2.2 - Total Soviet / Russian Grant Aid Arms Deliveries (1988-93)**  
(billion then year dollars)

<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
\$8.7	\$9.2	\$7.6	\$2.4	\$0.1	\$0.1

In the case of the U.S., military grant aid, which is included in the Foreign Military Financing (FMF) portion of Security Assistance, also fell. While the U.S. program provided \$3.2 billion in grant military assistance in FY 1993, that program almost exclusively concentrated aid payments on Egypt and Israel (\$1.3 billion and \$1.8 billion respectively). In total, U.S. discretionary grant aid dropped, in current dollars, from \$3.2 billion in 1984 to under \$700 million in FY 1989 to less than \$34 million in FY 1993. U.S. grant military aid data for 1989 and 1993 are shown in Table 2.3.

**Table 2.3 - U.S. Grant Military Aid: FY 1989 and FY 1993**  
(thousands current dollars)

	<u>FY 1989*</u>	<u>FY 1993</u>
<b>Africa</b>	\$24,700	\$15,000
<b>American Republics</b>	\$153,600	\$63,095
<b>East Asia &amp; Pacific</b>	\$148,000	\$15,000
<b>Europe &amp; Canada</b>	\$540,000	\$250
<b>Near East &amp; South Asia</b>	\$3,423,000	\$3,152,500
<b>Non Regional Grant Aid</b>	\$39,970	\$26,456
<b>Total</b>	\$4,329,270	\$3,272,301

\* FY 1989 includes Grant Military Assistance and Forgiven Foreign Military Sales Debts

## 2.4 Increased Concerns About Price and an Emphasis on System Upgrades

A factor having some influence on international arms trade is the ability of nations to pay for arms. In the post-Cold War era, many Western governments are reducing defense budgets. Also, many developing countries, with the exception of some oil rich states and wealthy East Asia nations, lack large cash reserves. Coupled with the reductions to grant aid, these nations are becoming more dependent on securing credit or other price or payment concessions from sellers in order to purchase arms.

For example, even Saudi Arabia is facing short term cash shortages. In 1994, Saudi Arabia has an obligation to pay \$3.35 billion to the U.S. for foreign military sales cases, and an obligation of \$4.6 billion programmed for 1995. To avoid jeopardizing a vital strategic and economic relationship, the U.S. plans to exercise unprecedented flexibility in collecting payments: Saudi Arabia will pay \$1.5 billion in cash, with the balance of the 1994 obligation financed.

Other countries in the region face similar difficulties. A deepening economic crisis may force Turkey to postpone, reduce in size, or cancel some defense procurement programs. Egypt has announced plans to finance the possible purchase of two diesel submarines (it is also considering the purchase of two excess U.S. FFG-7 frigates as an alternative use of its limited financial resources).

Many nations are turning to upgrades in an effort to improve the capabilities of existing systems at the lowest possible cost and to perform mid-life modernization of major weapon systems. Upgrades of tanks and fighter aircraft, for example, generally cost one-fourth the price of new systems, making them an attractive option for nations trying to lower defense expenditures.

Developing countries' fighter aircraft upgrade programs seek to increase combat capabilities by installing new electronics -- primarily avionics displays or weapon delivery systems -- and to extend the fighter's operational life by 10 to 15 years.

- Several former Soviet clients are considering upgrades -- Israel already has a contract to upgrade Mig-21s for Romania. India is in the process of negotiating a similar effort with the Russian firm Mikoyan .
- Chile has contracted with Israel to upgrade about one-half of its fleet of combat aircraft.
- Singapore is improving its A-4 Skyhawks with F104 engines and modern avionics.

- The European countries of Belgium, Denmark, the Netherlands, and Norway plan to invest about \$2 billion for joint production of components for their F-16 Mid-life Upgrade Program.

Foreign efforts to upgrade main battle tanks are primarily directed at providing improved fire control and night vision capability. Many of these efforts, however, are hampered by technical problems and a lack of funds. Another facet of the tank upgrade market is illustrated by the recent exhibition by both Slovakia and the Czech Republic of T-72 tanks produced with NATO-quality electronics and fire control systems. The Czech Republic has teamed up with Sagem of France to produce a new version of the T-72 containing the same stabilizing fire control system and electronics that Sagem installed in the latest French main battle tank; and it is being offered for one-tenth to one-fifth of the cost of any Western main battle tank. Slovakia unveiled its T-72M2 which is built with electronics and fire control systems produced and installed by a team from the Belgian firm Sabca and Britain's GEC Marconi; and is touted to cost less than half the price of a U.S. M1 series tank.

The long life of naval ships makes refit and upgrade programs a cost effective option for any country. For example,

- Indonesia is retrofitting its East German manufactured Kondor II class minesweepers with modern German minehunting sonars.
- Canada is upgrading its Tribal Class frigates with U.S. Standard surface-to-air-missiles, an Italian 76mm gun, Dutch fire control systems and radars, and U.S. Phalanx Close-In Weapon System anti-missile cannons.
- Taiwan is planning to upgrade its French-built Lafayette Class frigates.

## 2.5 Increased Demands for Advanced Munitions and Electronics

Desert Storm clearly demonstrated to foreign militaries the effectiveness of precision guided munitions and command, control, communications and intelligence (C3I) equipment. Demand for precision guided munitions is expected to be substantially higher in the 1990s than in the 1980s, resulting in increased deliveries over the remainder of the decade. Many of these deliveries are already on contract.

In an era of declining defense budgets, air forces are increasingly viewing standoff precision weapons as a cost-effective way to destroy targets and suffer fewer losses using fewer aircraft. Precision guided munitions also offer large potential logistics savings to countries that suffer major shortfalls in their ability to carry out operations of extended duration. The successful and highly publicized use of a variety of laser-guided bombs and air-to-surface missiles by

coalition forces during the Gulf conflict, combined with innovations that are making precision guided munitions easier to use and more lethal, are helping to increase sales.

Many countries -- especially in Europe and the Middle East -- already have plans to update or expand inventories. India and Pakistan are seeking precision attack weapons, while several East Asian nations are likely to purchase improved and guided munitions in substantial numbers. Purchases of laser-guided artillery projectiles are also planned by many countries.

Foreign governments recognize that C3I is crucial to the successful conduct of warfare in the 1990s. C3I represents the combined capacity to transmit orders to military units; to continually monitor and control the presence, movements and status of friendly forces; to be well-informed of enemy movements and intentions; and to be able to relay and receive messages quickly and secretly. The potential speed with which military units can move, the ranges over which weapons can be fired, and at the same time, the desire to maintain positive control of related military operations all increase the demand for C3I equipment.

Electronic warfare has emerged as a distinct military specialty that is being added to the arsenals of foreign forces. Electronic warfare is defined as the equipment, techniques, and methods intended to ensure the use for friendly forces of the electromagnetic spectrum for communications, surveillance, and weapon control, while denying those same uses to the enemy. Most armed forces are becoming increasingly dependent on electronics for C3I, surveillance, and fire control; and many modern weapons, including air-to-air and surface-to-air missiles, employ radar and other electromagnetic sensors or command guidance links. The use of C3I systems, electronic warfare equipment, surveillance aircraft, and other advanced support equipment is expected to grow.

- The demand for C3I equipment is growing as countries are emphasizing the development of integrated command and control networks. For example, General Electric has signed a \$313 million contract to upgrade Turkey's electronic warfare and C3 systems. In addition, France, Germany, Italy and Spain are teamed with the U.S. to produce data links allowing jam resistant exchange of tactical information.
- Demand for electronic warfare systems will rise as countries -- particularly in the Middle East and East Asia -- seek to equip new platforms and to modernize older equipment.
- Sales of surveillance aircraft will also probably grow. In Asia, Japan will import U.S. Airborne Warning and Control System (AWACS) aircraft, which incorporate both C3 and surveillance capabilities; Singapore has expressed interest in buying more AWACS aircraft; while Thailand, Indonesia, and South Korea are potential first time buyers.
- Over half of the nations of the world are seeking to improve reconnaissance capabilities by acquiring unmanned aerial vehicles (UAVs) of varying sizes and



capabilities. Thirty-five countries are now producing or developing more than 1,000 operational UAV systems.

- According to a market survey by Paris-based Sagem, the UAV market will grow to \$435 million by 1996, and more than double to \$1 billion by the year 2000.

## **2.6 Increased Buyer Leverage and Market Competition**

The downsizing of the international arms markets and the general decrease in defense spending by arms exporting nations has led to intense competition for arms export sales.

- Suppliers are competing for fewer and generally smaller sales.
- These sales are more important to the financial viability of supplier companies as their domestic business base declines.

Within this competitive environment, arms exporting countries are increasing support to their industries. The instances of senior level government officials lobbying for export sales have been increasing in the past few years. Similarly, government sponsored equipment exhibitions at trade shows are more prevalent.

Also within this competitive environment, arms buyers are demanding and obtaining significant, unprecedented concessions from suppliers. Financial problems in the buying country may also aggravate the situation by increasing buyer demands for lower prices, offsets, coproduction, and more concessional financing.

Financial concessions such as payment extensions may become a common part of the negotiations involving the Middle East, due to the current low prices for oil and natural gas. Additional requests can also be anticipated from purchasers for export loan financing, low cost credit, and even deferred payments. Developed countries that are attempting to sell military equipment may also be forced to use their knowledge and influence to create barter or counter-trade arrangements involving products from their customers. Customers with sufficient industrial infrastructure may request increasingly large industrial offsets or coproduction or codevelopment arrangements. Furthermore, demands by arms customers may also lead to requests for more or advanced training, long term support, and future upgrading allowances and model replacement.

Countries that are dependent on arms exports for a significant portion of their foreign exchange earnings will be particularly susceptible to these pressures. For example, the terms of a recent Malaysian purchase of Mig-29s from Russia called for approximately 25 percent of the purchase price to be in palm oil. In addition, Russian suppliers were required to establish joint

ventures with Malaysian companies to produce parts or provide training and maintenance services.

Similarly, the increased competition is leading suppliers to make unprecedented offers. With the formation of an aggressive arms export corporation called *Rosvooruzhenie*, Russia has offered India the ability to manufacture the advanced Su-30 long-range fighter/interceptor, currently operational only with the Russian Air Force.

With the abundance of willing suppliers, potential customers will increase demands for advanced technology products. Pressure can be applied to sell arms that may be just entering production, with the knowledge that major arms exporters need reasonable production quantities, now less likely to be attainable from domestic orders alone, to meet unit cost targets.

The Malaysian Mig-29 sale also illustrates this point. According to a quote attributed to the Malaysian defense minister, American aircraft were not originally purchased because "you [the U.S.] probably wouldn't be prepared to release your high-tech aircraft."

In addition, there will be increasing pressure for technology transfer. One area of intense pressure is software. The technical difficulty in developing the sophisticated software used in weapon systems and the desire to modify foreign-supplied equipment has led to this situation. Seller nations are being pressured to release the associated software source codes as a contract term in defense purchases. Other requests for technology transfer could lead to competition with the original arms exporter as the buyer nation develops its own indigenous capability in a specific technology application, not necessarily confined to military applications.

After buying the Mig-29s from Russia, the Malaysians ultimately decided to also purchase F/A-18s. But as part of that deal, they are also negotiating for advanced composite parts technology, work on commercial aircraft, and the establishment of a pilot training and maintenance center.

### 3. Requirements Driven Commodity Forecasts

*This chapter describes the development and results of forecasts of world-wide arms trade deliveries from 1994 through 2000 derived from requirements driven assessments. It is divided into five sections. Section 3.1 contains background information on the development of an arms trade database and on the forecast approach. Section 3.2 estimates the totality of arms trade world-wide by expanding the information in the database to account for both nations and categories of military items that have been excluded. Section 3.3 summarizes overall arms trade demand geographically for the Middle East, Asia, Europe, and the rest of the world. Section 3.4 provides a profile of the major arms suppliers in the world other than the U.S. Finally, Section 3.5 contains the buyer-seller-commodity specific forecasts. Forecasts were made in seven aggregate military item category groupings, roughly associated with industrial sectors -- aircraft, helicopters, ships, vehicles, missiles, artillery, and C3I systems. New system procurements were forecasted separately from upgrades.*

#### 3.1 Forecast Approach

DoD made requirements driven, commodity specific arms delivery forecasts, by country, for the period 1994 through 2000<sup>4</sup>. These forecasts were developed, automated, and entered into an Arms Trade Data Base (ATDB) created for this study. A four-step approach was used.

First, recognizing that only a small number of the more than 200 countries in the world make up the bulk of arms imports, a set of countries was selected for more detailed analysis. Selection criteria included economic strength, arms import history, and likelihood of purchasing from the U.S. In total, 37 countries were chosen, as illustrated in Figure 3.1. For 1992 and 1993, these countries received 92 percent of total U.S. arms exports and 80 percent of the arms exports from the rest of the world -- an overall average of 86 percent of global arms deliveries<sup>5</sup>.

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<sup>4</sup> Appendix A describes the development and results of an econometric forecast of the overall dollar value of arms trade deliveries from 1994 to 2000 to the principal purchasing geographical regions of the world. The forecast was developed to complement the requirements driven forecast documented in this chapter. Unfortunately, large differences between the upper and lower bounds of the econometric forecast limited the usefulness of the results in accomplishing the objectives of this study. The effects of the Cold War on the historical data greatly overshadowed the influences of other factors.

<sup>5</sup> 1991 data were excluded since they were somewhat distorted by the fact that former Warsaw Pact exports were still sizable.

**Figure 3.1 - Arms Trade Database Countries**

<b><u>Middle East</u></b> <ul style="list-style-type: none"><li>• Egypt</li><li>• Iran</li><li>• Israel</li><li>• Kuwait</li><li>• Saudi Arabia</li><li>• UAE</li></ul>	<b><u>East Asia</u></b> <ul style="list-style-type: none"><li>• Taiwan</li><li>• Indonesia</li><li>• Japan</li><li>• South Korea</li><li>• Malaysia</li><li>• Singapore</li><li>• Thailand</li><li>• China</li></ul> <b><u>South Asia</u></b> <ul style="list-style-type: none"><li>• India</li><li>• Pakistan</li></ul>	<b><u>Europe</u></b> <ul style="list-style-type: none"><li>• Austria</li><li>• Finland</li><li>• France</li><li>• Germany</li><li>• Greece</li><li>• Italy</li><li>• Norway</li><li>• Portugal</li><li>• Spain</li><li>• Sweden</li><li>• Switzerland</li><li>• Turkey</li><li>• UK</li></ul>	<b><u>Latin America</u></b> <ul style="list-style-type: none"><li>• Argentina</li><li>• Brazil</li><li>• Chile</li></ul> <b><u>Africa</u></b> <ul style="list-style-type: none"><li>• Algeria</li><li>• Morocco</li><li>• South Africa</li><li>• Tunisia</li></ul> <b><u>Oceania</u></b> <ul style="list-style-type: none"><li>• Australia</li></ul>
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The second step of the approach was to project the weapon requirements for each of the selected countries. In some cases, the requirements were ascertained as a result of past discussions with the subject country. In other cases, the requirements were determined on the basis of an analysis of the overall military situation facing the country, the evolution of technology, and the need to respond to potential enemies' evolving capabilities.

Once the requirements were estimated, the third step was an assessment of how those requirements would be met -- i.e., the acquisition strategy for these countries. Consideration was given to affordability, the country's technology base needs, the capability of the indigenous industrial base, the political situation within the country, and the threat perceptions. The output of this process was a set of commodity specific projections of arms imports throughout the decade. Figure 3.2 shows the individual military items included, and the way they were aggregated into seven category groupings for summarizing the forecasts. The military items being considered accounted for 90 percent of the dollar value of all arms deliveries to the ATDB countries on average in 1991 through 1993 when associated support costs were considered.

In the fourth and final step, assessments were made of the likelihood of an acquisition, the quantity that would be delivered within the study's time frame, the cost (defined to include both equipment and support), the potential sources, the determination of a systems upgrade versus new procurement, and the extent to which some coproduction arrangements would exist. Significant factors influencing these assessments include: prior buyer-seller relationships, the country's manufacturing capability, the types of equipment and support already in place, and the availability of financing. These assessments were then combined with deliveries already on contract to arrive at total projections for each country.

**Figure 3.2 - Arms Trade Database Categories**

<b><u>AIRCRAFT</u></b> <ul style="list-style-type: none"><li>• Attack</li><li>• Cargo</li><li>• Fighter</li><li>• Fighter/Attack</li><li>• Surveillance</li><li>• Tanker</li><li>• Transport</li><li>• Unmanned Aerial Vehicle</li></ul>	<b><u>HELICOPTERS</u></b> <ul style="list-style-type: none"><li>• Anti Submarine Warfare</li><li>• Attack</li><li>• Scout</li><li>• Utility</li></ul>	<b><u>SHIPS</u></b> <ul style="list-style-type: none"><li>• Carrier</li><li>• Destroyer</li><li>• Frigate</li><li>• Miscellaneous</li><li>• Submarine</li></ul>	<b><u>C3I SYSTEMS</u></b> <ul style="list-style-type: none"><li>• Communications</li><li>• Electronics</li><li>• Radar</li></ul>
<b><u>VEHICLES</u></b> <ul style="list-style-type: none"><li>• Armored Personnel Carrier</li><li>• Infantry Fighting Vehicle</li><li>• Miscellaneous</li><li>• Tank</li></ul>	<b><u>MISSILES</u></b> <ul style="list-style-type: none"><li>• Air-to-Air</li><li>• Anti-Tank</li><li>• Ballistic</li><li>• Cruise</li><li>• Precision Guided</li><li>• Surface-to-Air</li><li>• Torpedo</li></ul>	<b><u>ARTILLERY</u></b> <ul style="list-style-type: none"><li>• Air Defense</li><li>• Large Caliber</li><li>• Multiple Rocket Launcher</li></ul>	

Small arms were not included in the forecast because the focus of the study was on how U.S. arms trade policies might affect the U.S. share of global arms trade. U.S. small arms manufacturing is not a major component of U.S. international sales and small arms are not a large part of global arms trade. Many countries have their own indigenous small arms manufacturing capability, and therefore are not dependent on imports to acquire small arms. In addition, there is an inventory of literally millions of small arms available for sale in the marketplace.

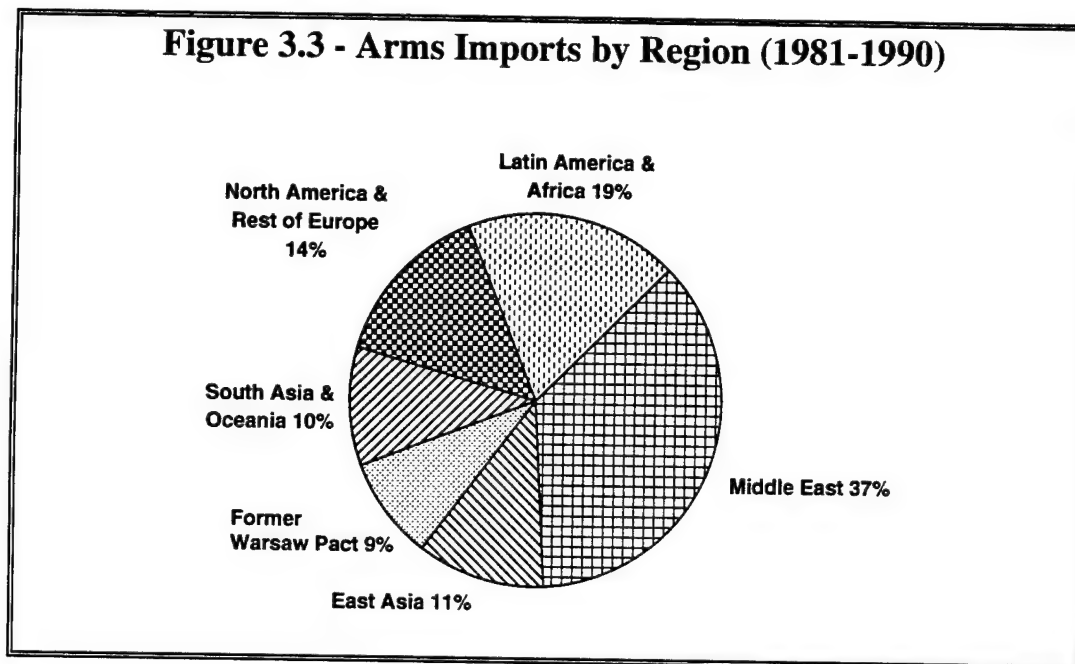
There are three limitations to this forecast approach. First, because deliveries were used, the possible impacts of new sales agreements over this time period were not fully measured in the analysis, since deliveries on these contracts might not occur until well into the next century. Second, the "make" versus "buy" decision was forecast on a case-by-case basis in the database. Therefore, the extent to which policies might affect a domestic production decision was not considered. Finally, with the exception of the European Helicopter Consortium, sales by international consortia were considered to be domestic production within countries with participants in the consortia. However, very few such sales were projected in the forecast timeframe. No forecast analogous to this exercise has ever been conducted, or published, in the past by DoD.

Despite these limitations, this study represents a major step forward in assembling a comprehensive future projection of exports by the U.S. defense industry.

### 3.2 Overall Arms Trade in the 1990s

Figure 3.3 summarizes arms imports by geographical region in the 1980s. In total, arms imports from 1981 through 1990 were approximately \$625 billion in 1991 dollars. Leading arms importers were concentrated in the Middle East (\$230 billion, or approximately 37 percent of arms imports) and East Asia (11 percent of arms imports).

Figures for individual years were consistent with this overall pattern. For example, in 1991, Saudi Arabia, Iran, Syria, and Israel accounted for \$9.6 billion or about 38 percent of world arms imports. In East Asia, arms imports by Japan, South Korea, Thailand, Taiwan, and China accounted for \$2.4 billion or almost 10 percent of 1991 world arms imports. Thus, a relatively few countries in the Middle East and East Asia accounted for almost half of 1991 world arms imports. The remaining half of 1991 arms imports was highly dispersed among 129 other countries.



The combination of Latin America and Africa imported nearly \$120 billion in arms in the 1980s. This sum equalled about 19 percent of total imports during that period. The former Warsaw Pact countries represented approximately nine percent of the 1980s total with more than \$50 billion in purchases. North America and the rest of Europe bought more than \$90 billion in defense equipment -- approximately 14 percent of the world total. South Asia and Oceania together accounted for about 10 percent.

Data in the ATDB indicate that arms trade deliveries of major equipment items to the ATDB countries from 1994 through 2000 will range between \$172.6 billion and \$202.5 billion in

1991 constant dollars. The upper bound was calculated on the basis of the higher cost estimate for every potential sale in the ATDB. The lower bound figure is based on the smaller cost estimate for only those potential sales with a medium to high likelihood of occurrence<sup>6</sup>.

To calculate projected total arms trade deliveries to all countries, three adjustments were made:

- (1) The ATDB 1994-2000 estimates of aggregate expenditures were increased to account for the fact that major commodities represent approximately 90 percent<sup>7</sup> of all defense equipment deliveries to the ATDB countries in 1991-1993.
- (2) Estimated 1994-2000 ATDB aggregate expenditures were further increased to account for the fact that deliveries to the ATDB countries comprised about 86 percent of global arms trade in 1992-1993.
- (3) The \$68.3 billion of actual world-wide arms trade (all countries, all items) in 1991 through 1993 was also included.

Based on these adjustments, global defense trade from 1991 through 2000 is projected to range between \$291.3 billion and \$329.9 billion in 1991 constant dollars. This represents a 47 to 53 percent reduction from the \$625.3 billion of total arms exports over the 1981-1990 time period. Given current arms trade experience, actual values will probably be much closer to the lower bound.

### 3.3 Aggregate Demand by Region

This section pictures total demand by region on the basis of the information in the ATDB. Therefore, the percentage breakdowns in Figure 3.4 represent only major military items and are based on the \$202.5 billion in deliveries by the 37 ATDB countries<sup>8</sup> aggregated geographically. The following four subsections discuss the regions in more detail.

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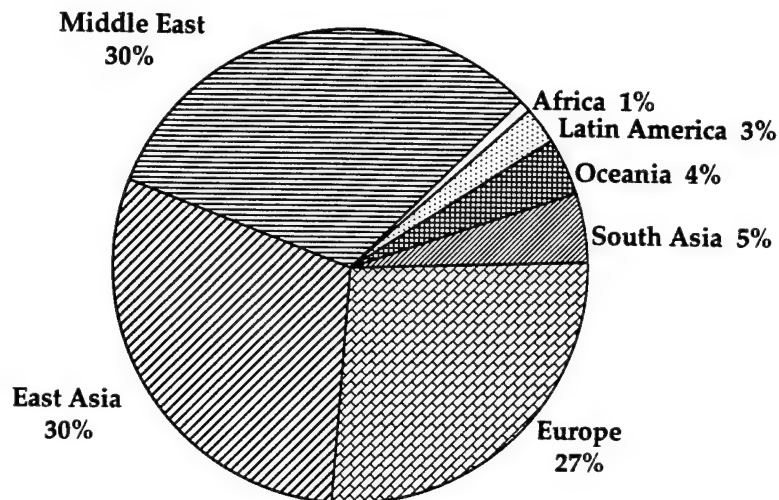
<sup>6</sup> This methodology for determining upper and lower bounds is used consistently throughout the report.

<sup>7</sup> 91 percent for the U.S., 89 percent for the rest of the world.

<sup>8</sup> The percentages are based on the upper bound defense trade delivery projections. Similar procedures were used to calculate the percentages for the remainder of the report, unless explicitly indicated otherwise.



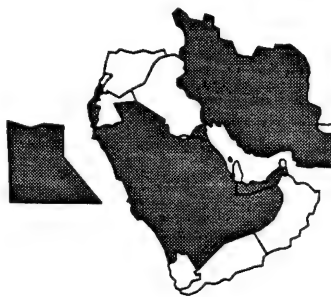
**Figure 3.4 - Projected World-Wide Demand by Region  
(1994-2000)**



### 3.3.1 Middle East Demand

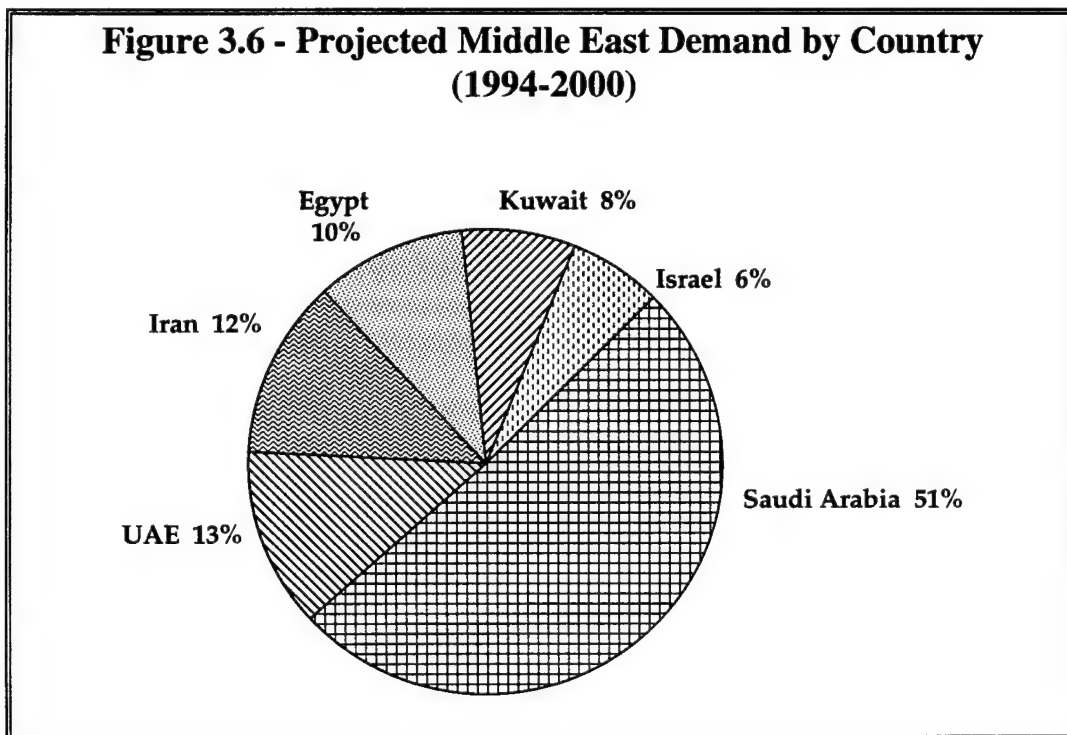
The Middle East region, with ATDB countries highlighted, is pictured in Figure 3.5. In 1991 constant dollars, projections of arms imports range between \$54.2 billion and \$63.6 billion for the ATDB Middle East countries for the remainder of the decade -- 1994 through 2000. These figures include only those major military items identified in the ATDB. The breakdown of these potential imports, by nation, is portrayed in Figure 3.6.

**Figure 3.5 - Middle East Region**



The Middle East region is expected to continue to be the world's largest market for arms through the rest of the decade, accounting for approximately 30 percent of all deliveries. East Asia will be a very close second.

Saudi Arabia will remain the world's largest arms importer and is expected to acquire an estimated \$32.4 billion in military equipment during the remainder of the decade. By itself, Saudi Arabia accounts for more than half of the total Middle East demand. Procurements will include advanced fighter aircraft, major ground arms and support equipment and systems. The Saudi government has already contracted for a range of equipment and support that includes the U.S. M1A2 tank, the F-15, the Bradley infantry fighting vehicle, and the British Tornado fighter. Major procurements for helicopters and electronic warfare equipment are also anticipated. Currently, the relatively low world market price levels for petroleum continue to hamper the potential procurement of frigates, tanker aircraft, and airborne warning and control systems. Depending on procurement needs and military concerns, transactions could be funded through loans, off-budget financing, or a stretch out of payments. Oil barter may be one of the more attractive Saudi payment options if oil prices remain at reduced levels. Not only would a market outlet be assured, but the visibility of any contractual discounts or commissions would be reduced or eliminated.



An additional \$13 billion in arms are expected to be delivered to Kuwait and the United Arab Emirates (UAE) -- other members of the Gulf Cooperation Council<sup>9</sup>. Sales will include advanced conventional weapons such U.S. Patriot missiles, AH-64 Apache attack helicopters and French LeClerc tanks. Kuwait accounts for eight percent of Middle East deliveries while the UAE is about 13 percent of the market.

Iran may spend as much as \$7.7 billion by the year 2000 for fighter aircraft, Scud missiles, attack boats, submarines, surface-to-air missiles, ship-to-ship missiles, tanks and armored personnel carriers. Russia, China, and North Korea will be Iran's main suppliers. Iran's arms imports represent 12 percent of all Middle East deliveries.

Egypt plans to buy tanks, other armored vehicles, anti-submarine warfare helicopters, and air defense missiles during the rest of the decade. In total, Egypt is projected to spend as much as \$6.7 billion for arms -- about ten percent of the Middle East market.

In addition to taking delivery on F-15 aircraft already purchased from the U.S., Israel plans to spend more than \$1.1 billion for a multiple rocket launching system and an air defense system. Israel accounts for approximately six percent of the Middle East demand.

### **3.3.2 East Asia, South Asia, and Oceania Demand**

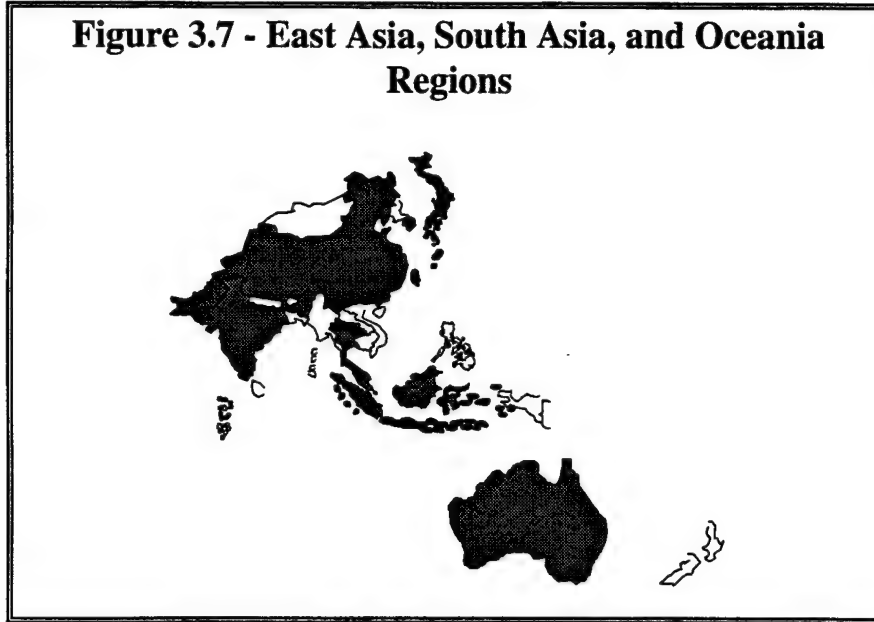
Figure 3.7 highlights the ATDB countries in East Asia, South Asia, and Oceania. For the commodities included in the ATDB, these countries represent between \$68.6 billion and \$77.6 billion, in 1991 constant dollars, in projected arms trade deliveries from 1994 through 2000. Figure 3.8 shows how these imports are estimated to be split among the countries involved. These large sales are driven by economic growth and historic rivalries.

East Asia arms import projections through the end of the decade are almost as large as those for the Middle East. Estimates range from \$53.7 billion to \$60.4 billion. Like the Middle East, East Asia is expected to account for 30 percent of world-wide arms trade through the year 2000. Taiwan, Japan, and South Korea are the three largest arms buying countries in the region and rank third through fifth world-wide, behind Saudi Arabia and Turkey, respectively.

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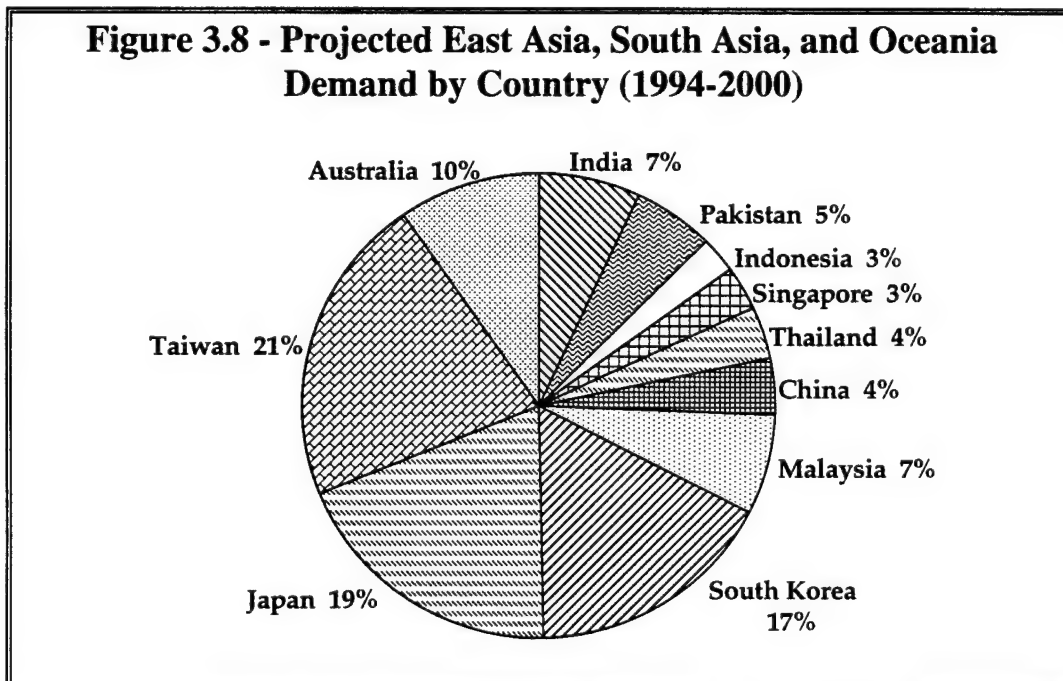
<sup>9</sup> The Gulf Cooperation Council includes Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

**Figure 3.7 - East Asia, South Asia, and Oceania Regions**



Taiwan is expected to take delivery of \$16.5 billion of defense equipment through the end of the decade. Imports include French Lafayette class frigates, Mirage 2000-5 and U.S. F-16 fighters. Additionally, U.S. firms are supplying technical and material assistance to Taiwan's multibillion dollar Indigenous Defense Fighter program. Taiwan is negotiating with the Netherlands and Germany for submarines and is shopping for U.S. and other Western supplied missiles, naval guns, radar and sonar to equip its frigates. Taipei may encounter difficulties in obtaining some arms, due to Chinese efforts to preclude certain arms transactions with Taiwan.

**Figure 3.8 - Projected East Asia, South Asia, and Oceania Demand by Country (1994-2000)**



Japan will be East Asia's second biggest arms importer, procuring between \$13.9 billion and \$14.8 billion of arms imports. Japan will continue its planned acquisitions of U.S. supplied equipment including AWACS aircraft, the Aegis missile defense system, the Multiple Launch Rocket System, and equipment for the FSX indigenous fighter codevelopment program. A reduction in the former Soviet threat to Japan resulted in cutbacks in Japan's Type-90 tank and F-15 interceptor acquisition programs.

South Korea plans to address the North Korean military's numerical advantages through acquisition of technologically advanced weapon systems. Projected deliveries in the remainder of the decade total between \$11.8 billion and \$13.5 billion. South Korea has entered a coproduction arrangement to build U.S. F-16 fighter aircraft and has purchased U.S. P-3C maritime patrol aircraft. South Korea's long term naval development plans call for establishing a blue water fleet including domestically produced KDX destroyers equipped with Western combat systems and German Type-209 submarines. South Korea intends to bolster its ground forces by license producing its K-1 main battle tank and purchasing surface-to-air missiles, self propelled artillery, and attack and utility helicopters.

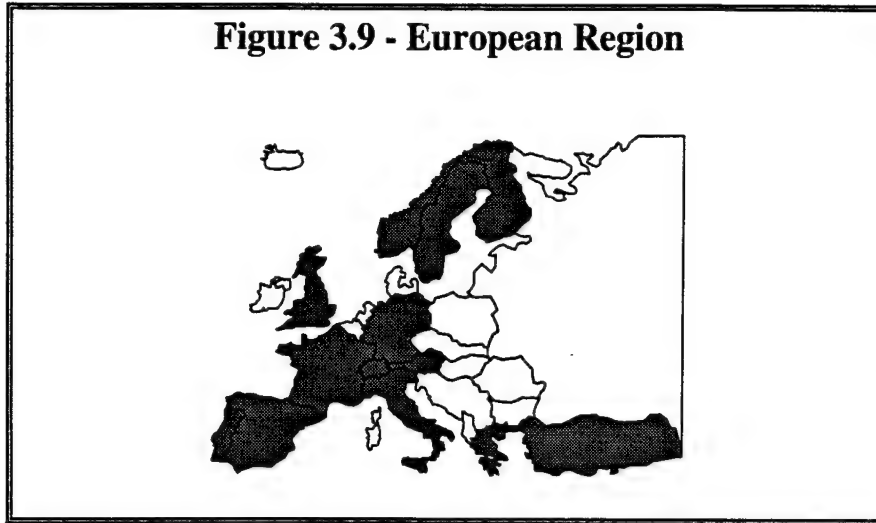
South Asia arms acquisitions from 1994 to 2000 are estimated to range from \$7.4 billion to \$9.5 billion, accounting for five percent of the world-wide market. Both India and Pakistan are planning purchases of tanks, artillery, helicopters, fighter aircraft, and air defense systems.

Oceania arms imports are expected to reach \$7.6 billion in the rest of the 1990's -- four percent of arms trade deliveries world-wide. Australia will account for the bulk of these deliveries, as an ambitious air and surface modernization program, tailored to support Australia's two ocean doctrine, dominates this region's arms imports. Deliveries over the period include those associated with Australia's major planned purchases of maritime patrol aircraft, frigates and submarines.

### **3.3.3 European Demand**

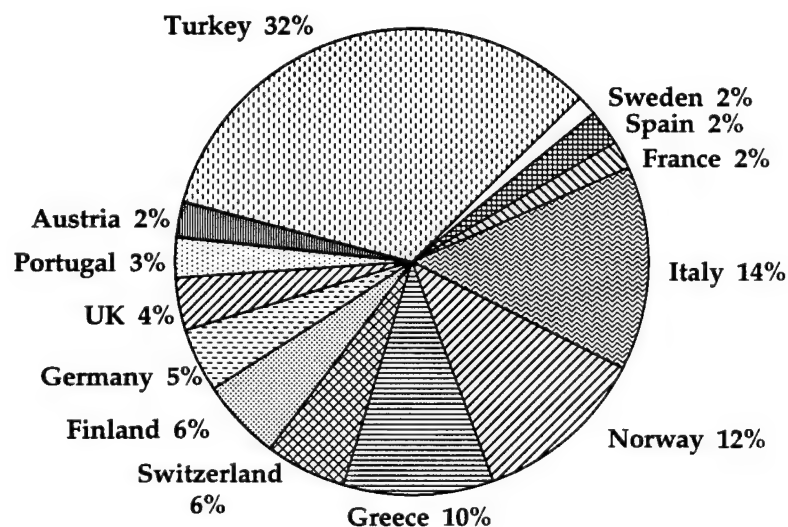
The European region is defined in Figure 3.9 -- the ATDB countries are highlighted. In the 1994 to 2000 time period, deliveries of major military items to the ATDB European countries will range between \$46.2 billion and \$53.9 billion in 1991 dollars, accounting for 27 percent of world-wide arms acquisitions. Figure 3.10 shows the percentage of regional imports by country.

**Figure 3.9 - European Region**



About 75 percent of the deliveries to European countries through the end of the decade are already under contract. Two conflicting pressures characterize European arms imports. First, there is a strong tendency for European countries to purchase weapon systems and related defense items from other European countries whenever possible. On the other hand, the downsizing in defense budgets is leading to a reevaluation of costly indigenous or codevelopment programs. Market shifts may favor the purchase or coproduction of U.S. or French fighters if Britain, Germany, Italy, and Spain decide to abandon their Eurofighter 2000 project.

**Figure 3.10 - Projected European Demand by Country  
(1994-2000)**



Southern European countries account for a majority of the purchases yet to be made that will result in deliveries over the forecast period. Turkey is estimated to be the second largest arms importer in the world, with estimated delivery values from \$16.4 billion to \$17.9 billion. Potential arms purchases include tanks, multiple rocket launchers, cargo aircraft, airborne surveillance systems, refueling aircraft, Patriot and Stinger air defense missiles, anti-submarine warfare helicopters, and minehunter hulls. Potential Greek deliveries range between \$4.1 billion and \$5.5 billion and include multiple rocket launchers, training aircraft, reconnaissance aircraft, attack helicopters, Patriot batteries, anti-radiation missiles, and air-to-air missiles.

Norway and Switzerland also plan for some sizable purchases not already under contract. Combined arms imports may be as high as \$9.4 billion. Norway may buy air-to-air missiles, multiple rocket launching systems, sea mines and anti-submarine warfare torpedoes. Switzerland has expressed interest in multiple rocket launching systems, airborne surveillance systems, surface-to-air missiles, and anti-tank missiles.

Although not in the ATDB, former Warsaw Pact countries are expected to slash their imports by more than 50 percent from their aggregate \$55 billion level in the 1980s. They will mostly be characterized by Russian supplied arms provided in exchange for debt forgiveness. The end of arms imports from the former East Germany (which were one-fifth of the Pact's total), significant economic difficulties, and large military force reductions in these countries will contribute to the decline.

### **3.3.4 Africa and Latin America Demand**

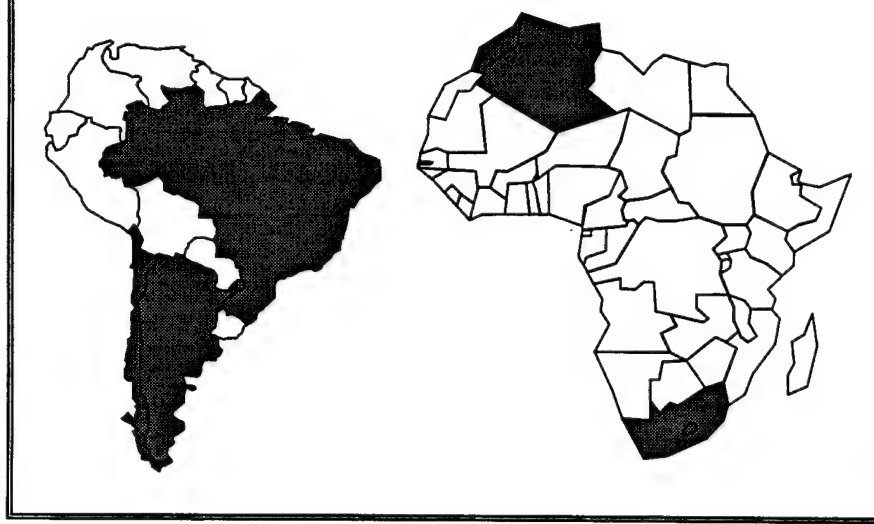
Countries in the ATDB in Africa and Latin America are highlighted in Figure 3.11. Figure 3.12 shows the breakdown of projected ATDB major defense item sales among the countries involved<sup>10</sup>. While these areas in the world represent places of potentially high regional instability, the total dollar value of potential arms sales is relatively small. For the remainder of the decade, imports of major defense items for these countries are expected to range between \$3.6 billion and \$7.3 billion in 1991 constant dollars.

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<sup>10</sup> Egypt is included in the Middle East region.

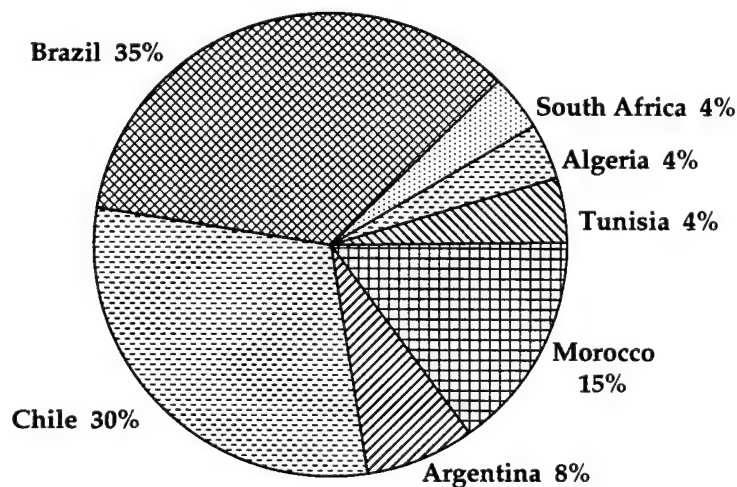


**Figure 3.11 - Africa and Latin America Regions**



Africa represents only about one percent of world-wide arms sales, with projected expenditures as high as \$2.0 billion. The key projected acquisitions by African countries include both new and used fighters and other aircraft, as well as surplus armor and ships. Algeria is expected to rely on Russian equipment. Morocco has expressed interest in the purchase of F-16s or Mirage 2000s, as well as training aircraft and UK Lynx helicopters. Tunisia plans to purchase U.S. C-130 aircraft; additional purchases of F-5 or A-7 combat aircraft are possible.

**Figure 3.12 - Projected Africa and Latin America Demand by Country (1994-2000)**



Latin American arms procurement may range between \$3.6 billion and \$5.2 billion -- about three percent of the market. Funding constraints are expected to continue to limit the purchases of even the highest priority arms imports by Latin American governments. Emphasis will continue to be placed on procurements in response to regional rivalry as well as for internal security requirements to combat insurgencies or drug traffickers. Equipment upgrades will become a priority as these nations attempt to maintain their conventional forces with limited funds. Financing of major imports will remain questionable. Brazil has expressed interest in buying fighter aircraft and surveillance aircraft. Approximately 50 percent of Argentina's arms imports are already under contract. Chile may seek to acquire fighter aircraft, cruise missiles, and torpedoes.

### 3.4 Supplier Profiles

Table 3.1 shows the top six arms supplier countries based on 1992 and 1993 deliveries. These countries accounted for more than 90 percent of the world-wide totals. Although the rankings varied in each year, the same countries comprised the top six suppliers for both years. Exporters of advanced equipment and firms specializing in certain niche markets are expected to be the most successful military suppliers for the remainder of the decade. France, Germany and the UK are projected to be the largest arms exporters behind the U.S. Export of Soviet-style arms are not expected to increase significantly from their current reduced levels for the remainder of the 1990s.

**Table 3.1 - Top Six Arms Supplier Countries (1992-93)**

(billion constant 1991 dollars)

<u>Country</u>	<u>1992 Sales</u>		<u>1993 Sales</u>	
	<u>Dollars</u>	<u>Percent</u>	<u>Dollars</u>	<u>Percent</u>
U.S.	10.3	46	10.8	53
UK	4.3	19	4.1	20
Russia	2.3	10	2.5	12
Germany	1.1	5	1.1	5
China	0.8	4	0.9	4
France	1.4	6	0.6	3

Note: U.S. figures are based on estimates made in July 1994 to be consistent with the rest of this report. Figures for other nations are current as of December 1994. Percentages derived on the basis of totals as estimated in July 1994.

## Major Foreign Exporting Countries

Reduced global demand for major arms in this decade will result in a dramatic decline in France's arms exports from the \$50 billion level sold during the 1980s. However, France is still expected to be the world's second largest arms exporter over the remainder of this decade. French arms exports cover almost the entire spectrum of conventional arms. Competition from the French arms industry will continue to be effective in several important markets such as those for tactical missiles, military electronics, and advanced naval equipment. Aerospatiale's new MM40 Block 2 Exocet anti-ship missile will be a rival to the U.S. Harpoon because of its flexible targeting capabilities and a somewhat stealthier flight profile. Several countries in Europe, East Asia, and the Persian Gulf are potential candidates to equip their naval combatants with French anti-ship cruise missiles. Aerospatiale is also targeting existing U.S. export customers for its improved AS-30L missile, modified for operation with the F-16. French firms are projected to capture a larger share of the precision guided munitions market in the mid-1990s with the planned introduction of the Apache modular, autonomous standoff munition. Additionally, the MICA air-to-air missile will compete with the U.S. AMRAAM for air-to-air missile sales to a wide range of customers during the decade.

The UK will remain a viable competitor in the international arms market and should be able to sustain its past export levels, which totaled more than \$35 billion during the 1980s. Naval systems being marketed by the UK include surface ships, diesel submarines, anti-submarine warfare and utility helicopters, and fixed wing maritime patrol aircraft. Malaysia, Oman, Qatar, Saudi Arabia, and Spain are buying various types of coastal combatant ships, and Australia is interested in British minehunter vessels. In the aircraft markets, the Hawk attack/trainer aircraft continues to be competitive because of its cost, simplicity, and flexibility. Smiths Industries and the General Electric Company of the UK are strong competitors in the fighter upgrade market with their systems integration efforts and equipment for weapon delivery and cockpit displays. Army and naval versions of the Westland Lynx helicopter have been and are projected to continue to be very competitive systems in the global helicopter market.

Germany is projected to become one of the leading arms exporters in the 1990s. German weapon system exports will be concentrated primarily in the aircraft and ship markets. The Alpha jet trainer is projected to be competitive in the large global trainer aircraft market because of its favorable cost and performance characteristics. German naval exports are projected to dominate the global submarine market and to be very competitive for sales of frigates, smaller vessels, and torpedoes to a variety of prospective buyers. In addition, Germany recently signed a major contract with Sweden to sell Leopard II tanks. As a consequence of the downsizing of the German armed forces, a significant portion of German arms exports will also include used equipment that is no longer needed by the German military. Transfers of M113 armored personnel carriers to Portugal, as well as RF-4 reconnaissance aircraft to both Greece and Turkey are anticipated during this decade.

## Minor Exporting Countries

Minor exporting countries can generally be categorized into two groups: Suppliers marketing sophisticated, modern systems and suppliers marketing older, less sophisticated weapon systems, generally to buyers from developing nations. All of the minor exporters will face increased competition for fewer sales in the current decade; analogous to the situation facing the larger exporters. However, due to their smaller arms industries and limited resources, many minor exporters will target niche markets. The sales prospects for the more sophisticated minor exporters are more stable than those for less sophisticated suppliers like China, North Korea, and the East European countries. Without a conflict such as the Iran-Iraq war, there is declining demand for most of the outdated arms offered by the latter group.

Italy, Spain, and Sweden are nations with well developed defense industries, a history of arms exports, and significant prospects for continued arms exports throughout the decade to a variety of buyers. Italy's arms exports will focus on transport aircraft and smaller naval vessels and combat systems, targeting customers such as Argentina, Australia, Japan, Malaysia and Pakistan. Italy is a member of the European Helicopter Consortium, along with France, Germany, and the Netherlands, which is currently developing the NH-90 transport helicopter for the European market. Spain is a strong competitor in the transport aircraft market with prospects for sales to a number of nations including Australia, Chile, Indonesia, Malaysia, Morocco, South Korea, Tunisia, and Turkey. Spain is also a player in the minor combatant vessel export market, targeting Egypt, Morocco and Thailand. While Sweden's Gripen aircraft is not expected to be a major competitor in the global multi-role fighter aircraft market, Swedish submarines and naval combat systems are strong competitors in the global naval market with potential sales to Australia, Norway, Pakistan, and South Korea. Sweden also produces infantry fighting vehicles for export, with prospects for sales to Norway and Saudi Arabia.

Israel is becoming more active in the international arms export market, building on its experience in providing advanced military equipment and technology to a variety customers. Israel has developed into a world class supplier of electronics and tactical missiles, and will remain a strong competitor in the global aircraft and armor upgrade markets during this decade. Israeli firms obtained good market visibility when they won the contract to upgrade Mig-21s for Romania and are competing for more contracts to upgrade aircraft for a number of nations including Australia, Bulgaria, Chile, India, and Spain. In addition, Israel is actively promoting naval electronic warfare equipment and missile sales. Israel is also recognized as one of the world's leading UAV producers, a market segment with substantial growth potential in the future.

Brazil's arms exports are trainer aircraft and multiple rocket launch systems. The AMX fighter is coproduced with Italy and has no significant prospects for export in the near future. The Tucano trainer represents the nation's most promising aircraft export potential with strong prospects for sales throughout the decade. Brazil's multiple rocket launch system is in competition for sale to the United Arab Emirates among others.

Although the Soviet Union was the largest arms exporter during the Cold War, Russia has not been able to maintain anywhere near the previous level of arms exports since the end of the Cold War. Russian military systems available for export cover the whole market spectrum; however, prospects for sales during the 1990s are limited. Russia is marketing a variety of aircraft (including its most advanced fighters), armored vehicles, naval systems, and missiles throughout the world, but with limited success. Overall, export sales projections for Russian arms, in dollar terms, remain low.

China's success as an arms exporter in the 1980s was directly attributable to the Iran-Iraq war. However, it faces more limited market prospects for this decade without an ability to provide clients with advanced weapons. Chinese exports have held at \$1 billion or less over the past three years. China will continue to rely on the sale of cheaper major systems such as the F-7 fighter to countries such as Iran, Pakistan, and Burma that lack access to or cannot afford more advanced systems. However, China is already facing increased competition for some of these customers, as France and Britain are promoting exports to Pakistan. China is currently attempting to improve its international sales, in part by obtaining technological assistance from Russia. Moscow has been willing to assist with a number of Chinese programs, including the new Super-7 fighter plane. Even with Russia's help, this aircraft is not scheduled for delivery until the latter part of the decade.

At the low end of the market, former Soviet countries can offer equipment that is cheaper than Western arms and usually superior to Chinese products. As early as 1990, Russia replaced China as Iran's biggest arms supplier. Even Poland and Bulgaria have successfully competed against the Chinese for Iranian ground and missile systems projects.

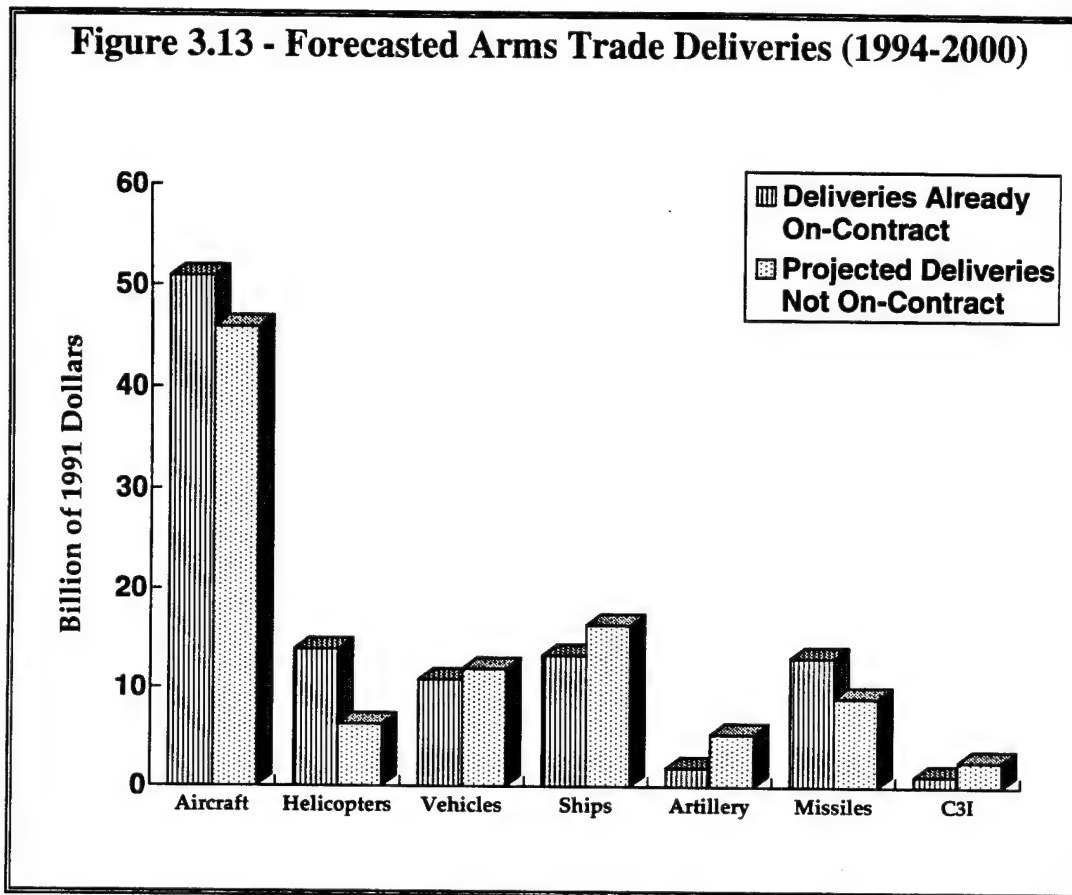
Eastern European countries might be able to hold their own in the sale of their basic ground armaments and certain specialized items, such as jet trainers and electronic equipment, for the remainder of the decade. Overall export sales will decline, however, for the next few years.

### 3.5 Commodity Forecast Results

Figure 3.13 shows the breakdown by major defense item category of the \$202.5 billion upper bound of ATDB deliveries, in 1991 constant dollars. Figure 3.13 also indicates whether the delivery is already under contract or is the result of a projected future sale.

In total, \$106.5 billion of the forecasted arms trade deliveries are already under contract, and future contracts are expected to generate an additional \$96.0 billion in deliveries. Aircraft deliveries represent the bulk of the market, with deliveries from future contracts expected to be about ten percent lower than deliveries from existing contracts. The corresponding decline for helicopters is estimated to be 50 percent, meaning two thirds of forecasted helicopter deliveries

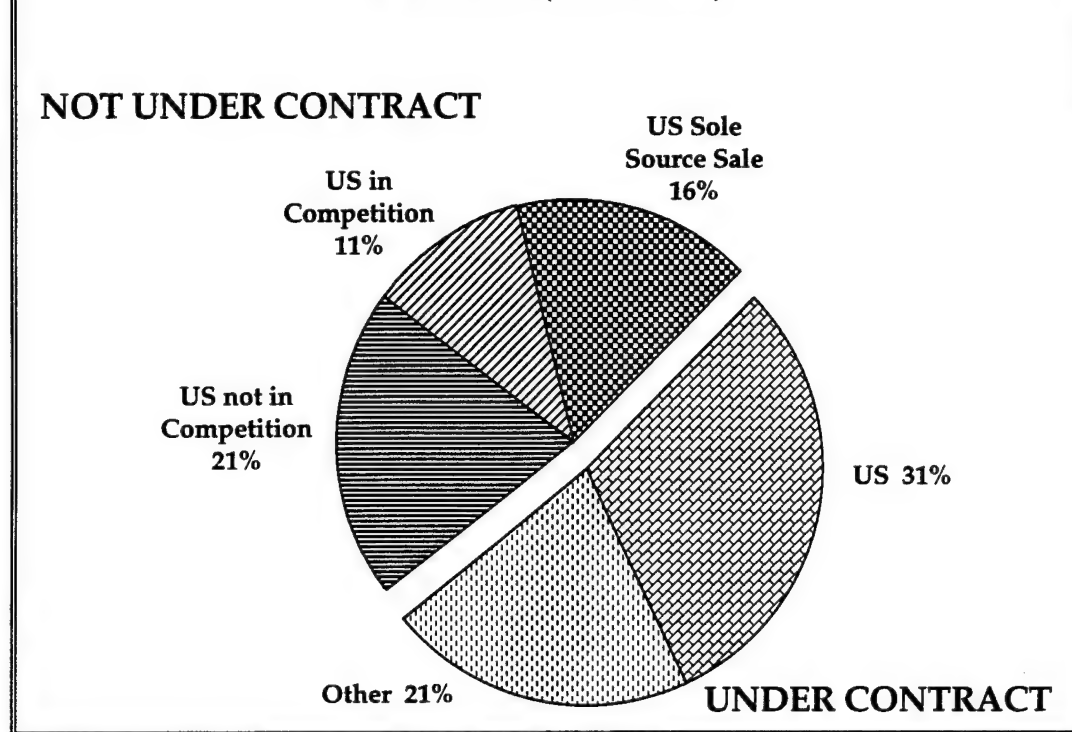
are already under contract. Also, deliveries from future missile contracts are expected to be approximately 30 percent lower than already contracted deliveries.



For the remaining ATDB categories, the deliveries from future contracts are higher than deliveries currently under contract. The projected increases are ten percent for vehicles and 20 percent for ships. C3I, an anticipated growth area, shows a projected increase of more than 100 percent. While future contracts for artillery systems show an even higher growth rate, this projection is indicative of uncertainty in the market. If Figure 3.13 were constructed for the lower bound sales scenario, the artillery increase would be almost nil, while the C3I increase would remain above 100 percent.

Figure 3.14 shows that, in total, existing contracts account for between \$102.9 billion and \$106.5 billion, about 52 percent of the ATDB data. The U.S. share is about 63 percent. The ATDB forecasts between \$69.5 billion and \$96.0 billion of deliveries for future contracts. Based on the ratio to the larger of the two numbers, more than one third of these deliveries will be from competing contracts expected to be sole source to the U.S. The U.S. will be in competition for an additional 25 percent of the contracts. The U.S. will not compete for the remaining portion (42 percent) of these sales.

**Figure 3.14 - Supplier Market Share of Total World-Wide Arms Deliveries (1994-2000)**



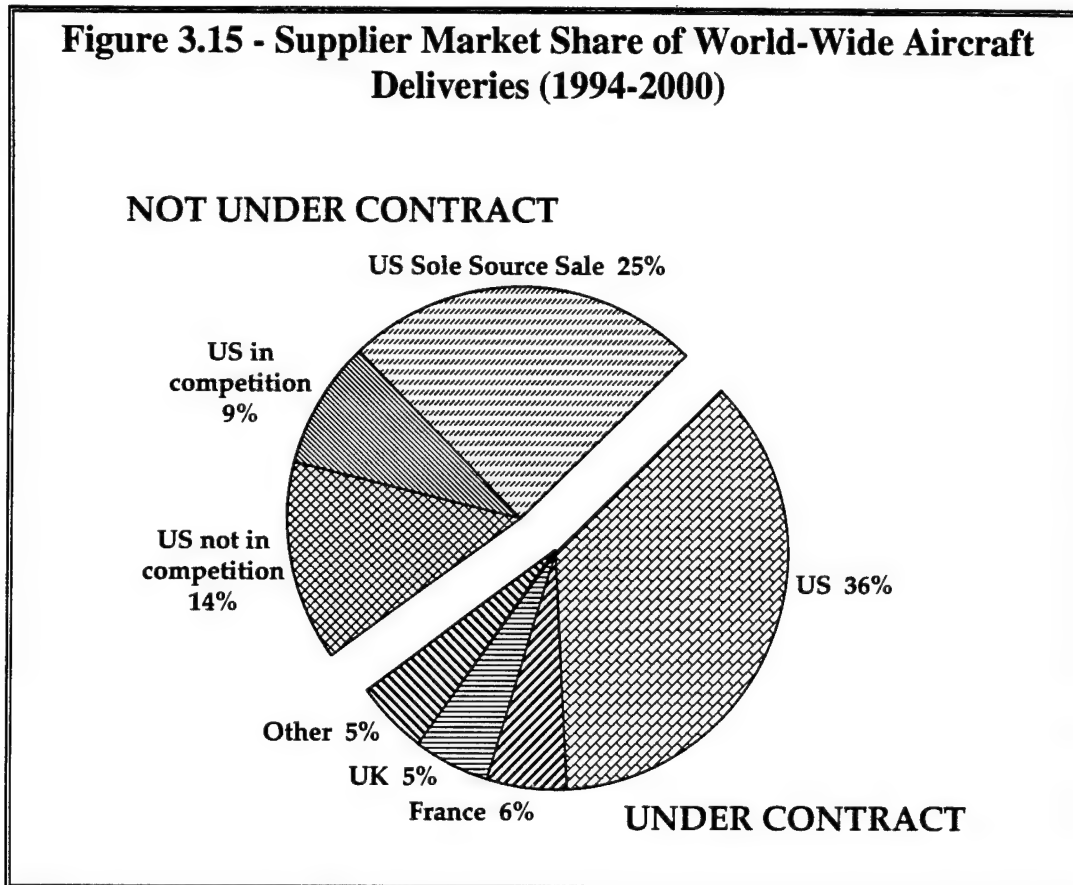
The following seven subsections discuss each of these categories individually. Included in each of these subsections is a pie chart profiling supplier country market share of world-wide deliveries. These pie charts are similar in format to Figure 3.14 which shows data for all commodities combined.

Figure 3.14 and the subsequent commodity pie charts are divided into two sections -- "under contract" and "not under contract". The "not under contract" section is further divided into sales projections where (1) the U.S. is believed to be the sole source, for reasons such as interoperability with existing equipment, buyer stated intentions, and unique capabilities not offered by competing producers; (2) the U.S. is in competition with other countries for the sale; and (3) the U.S. is not competitive for the sale, based on such factors as who the buyer is and the buyer's stated (or assumed) intentions.



### 3.5.1 Aircraft Forecast

Figure 3.15 depicts global aircraft market deliveries projected in the ATDB for the remainder of the decade. In total, this market may range from \$85.6 billion to \$96.7 billion in constant 1991 dollars -- about 51 percent of the revenue in the ATDB. Attack, cargo, fighter, fighter/attack, surveillance, tanker, and trainer aircraft are all included.



Existing contracts account for 52 percent of the total deliveries and are valued between \$49.4 billion and \$50.9 billion. The U.S. 36 percent share of the global market represents between \$35.0 billion and \$35.5 billion -- nearly 3,000 new aircraft and almost 400 aircraft upgrades. France is projected to be the second leading aircraft supplier with six percent of the market under contract, consisting solely of Mirage 2000-5 fighters. The UK contracts for deliveries of approximately \$5 billion constitutes about five percent of the total market. Other suppliers with contracts include Brazil (\$1.4 billion), Spain (\$1.0 billion), Germany (0.8 billion), Russia (0.8 billion), Czech Republic and Slovakia (\$0.4 billion), Israel (\$0.5 billion), Belgium (\$0.1 billion), China (\$0.1 billion), and Netherlands (\$0.1 billion).



Aircraft upgrades under contract to the U.S. consist of work on U.S. aircraft as well as one transaction involving Tornados for Italy. France is also modifying Tornado aircraft. Israel's upgrade sales include improvements to an assortment of old and new French and U.S. aircraft.

Approximately 1,500 new aircraft sales and nearly 400 aircraft upgrades are not yet under contract, but are projected for delivery by the year 2000. The U.S. is estimated to be the sole source for 25 percent (\$20.1 billion to \$23.9 billion) and in competition for another nine percent (\$6.3 billion to \$8.4 billion) of these deliveries on future sales. The U.S. is not competing for another 14 percent of the market, valued between \$9.5 billion and \$15.5 billion, where the buyer either is unwilling to purchase from the U.S. or the U.S. would not sell to the buyer country.

For sales not under contract, principal U.S. competitors for attack and fighter aircraft are France and Russia; surveillance aircraft competitors include France, the Netherlands, and the UK. The U.S. is competing against France and Switzerland for a sale of fighter/attack aircraft to Austria. The U.S. has good potential in the lucrative fighter and surveillance aircraft categories. The U.S. is expected to face competition from Spain for a sale of 40 Harrier attack aircraft to Thailand. The trainer aircraft category has no U.S. presence. For upgrades not under contract, principal U.S. competitors are France and Israel.

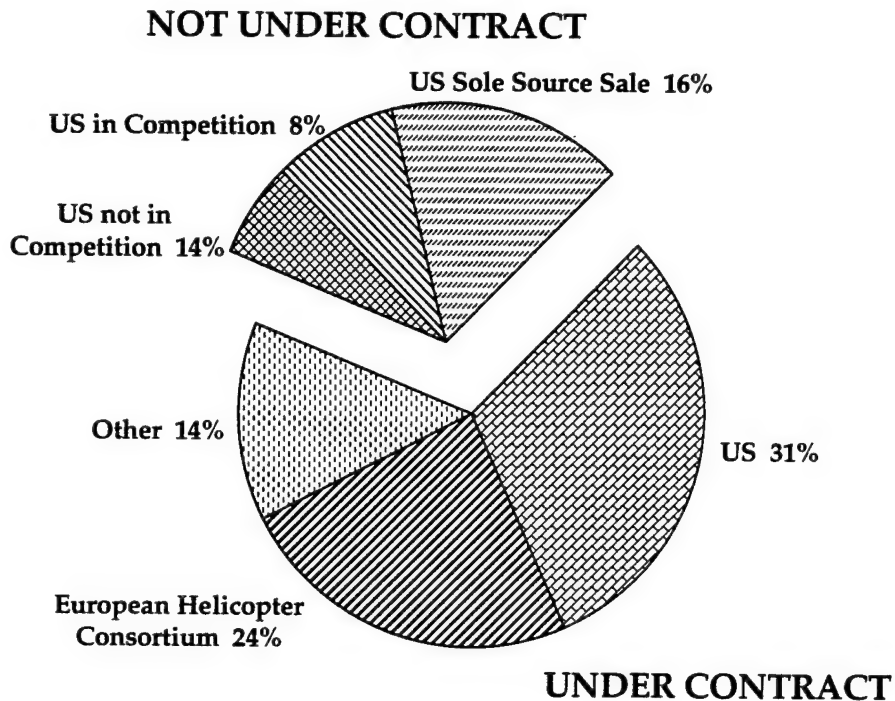
In summary, the U.S. accounts for 70 percent of the deliveries already under contract and between 52 and 71 percent of deliveries not under contract. The U.S. share of total aircraft deliveries ranges between 61 and 70 percent of the market. These percentages are roughly insensitive to the use of the upper or lower bound of the aircraft delivery estimates.

### **3.5.2 Helicopter Forecast**

Figure 3.16 contains the percentages of world-wide anti-submarine warfare, attack, scout, and utility helicopter and helicopter upgrade deliveries from 1994 to 2000, based on information in the ATDB. The size of this market, which is approximately ten percent of total arms deliveries, is estimated to vary between \$19.1 billion and \$20.2 billion in 1991 dollars.

The U.S. 31 percent share of all deliveries under existing contracts includes more than 750 new helicopter sales, valued at \$6.2 billion. The deliveries are composed primarily of Apache attack and Blackhawk utility helicopters. A European helicopter consortium closely follows the U.S. with 24 percent of deliveries already under contract -- consisting entirely of NH-90 utility helicopters. The remaining suppliers of helicopters already under contract include France (\$0.2 billion), the UK (\$0.9 billion), and Italy (\$1.6 billion).

**Figure 3.16 - Supplier Market Share of World-Wide Helicopter Deliveries (1994-2000)**

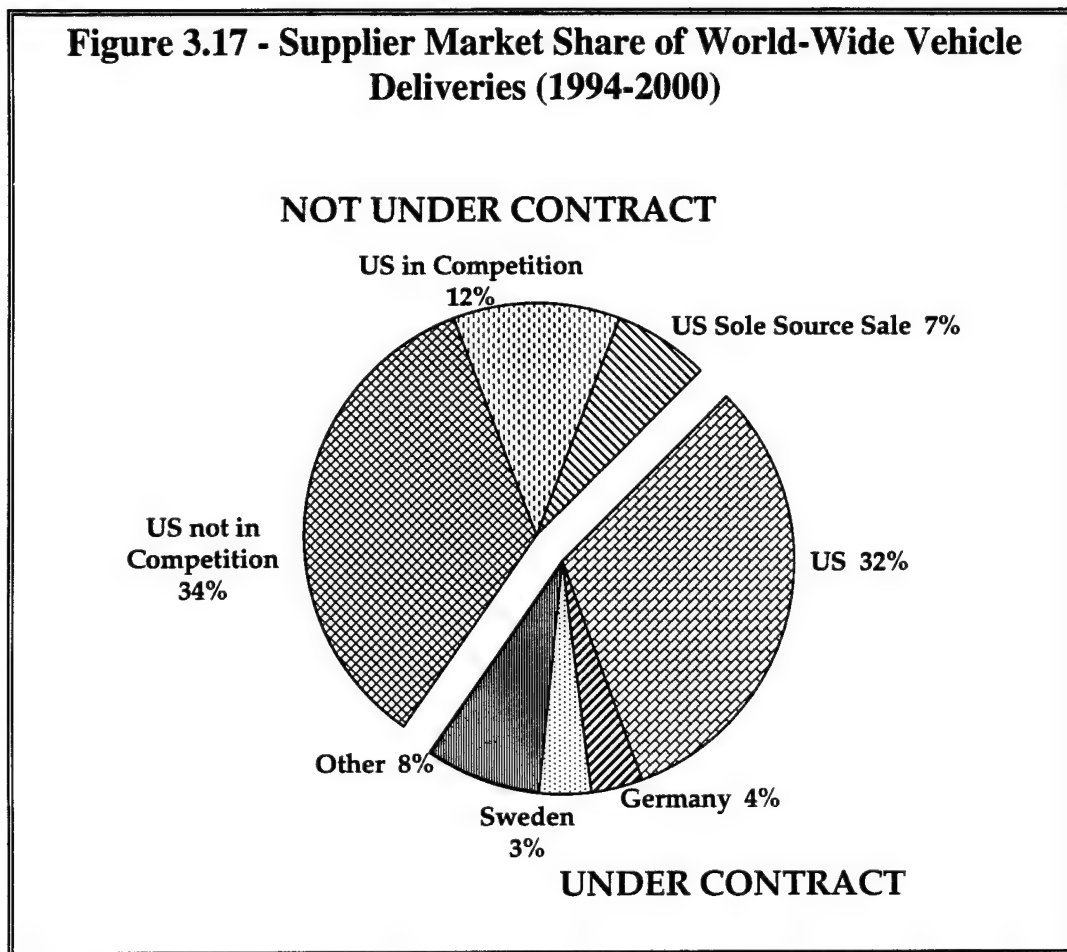


Future sales are projected to account for nearly 500 additional helicopters. The U.S. is projected to be the sole source for between 76 and 79 percent, valued between \$2.5 billion and \$3.3 billion, of deliveries from future sales. The U.S. is in competition with products from France, Germany, the UK, and Russia for an additional \$1.5 to \$1.7 billion in deliveries from utility helicopter sales. The U.S. will not compete for the remaining \$1.2 billion to \$1.3 billion in deliveries not under contract.

In summary, the U.S. contracts for helicopter deliveries equate to 45 percent of all currently contracted helicopter deliveries. The U.S. potential share of deliveries from future contracts ranges between 52 and 79 percent of the market. In total, the U.S. market share is projected to vary between 47 and 56 percent of the global helicopter market. These findings apply to both upper and lower bound helicopter delivery estimates.

### 3.5.3 Vehicle Forecast

Global vehicle deliveries are portrayed in Figure 3.17. Total dollar values of these deliveries may range, in 1991 constant dollars, from \$18.3 billion to \$22.7 billion, according to the ATDB. This market includes new sales and upgrades of armored personnel carriers, infantry fighting vehicles, miscellaneous vehicles, and tanks. Vehicle deliveries account for about 11 percent of all arms trade through the year 2000.



The portion of Figure 3.17 depicting existing contracts is between \$10.6 billion and \$10.8 billion. With percentages expressed for the total market, the U.S. 32 percent share for new vehicle deliveries from existing contracts is valued at \$7.3 billion, consisting primarily of sales of M1 tanks and infantry fighting vehicles. The U.S. has no contracted vehicle upgrade deliveries. Germany is second to the U.S. with only four percent of the market -- \$0.9 billion of deliveries under contract consisting of armored personnel carriers and tanks. Sweden will deliver about \$0.8 billion in vehicles (three percent of the market) from existing contracts, primarily armored personnel carriers to Norway and Saudi Arabia. Some other suppliers with existing contracts

include Canada (\$0.6 billion), Russia (\$0.4 billion), the UK (\$0.3 billion), China (\$0.1 billion), and South Korea (\$0.1 billion).

Vehicle exports not yet under contract are estimated to total between \$7.7 billion and \$11.9 billion. The U.S. is expected to be the sole source supplier for \$0.9 billion to \$1.5 billion representing seven percent of the global market. The U.S. is in competition for deliveries of another 12 percent (\$2.6 billion). These deliveries would be for infantry fighting vehicles to Switzerland, in competition against products from Germany; armored personnel carriers to Kuwait and Egypt, in competition with Canada and the Netherlands, respectively; and a tank sale to Saudi Arabia, in competition against the UK. The U.S. is not expected to compete against a potential Russian tank sale to India and a Swiss/Canadian armored personnel carrier sale to Saudi Arabia. Vehicle upgrades not yet under contract are dominated by expected large tank upgrades in India and South Korea.

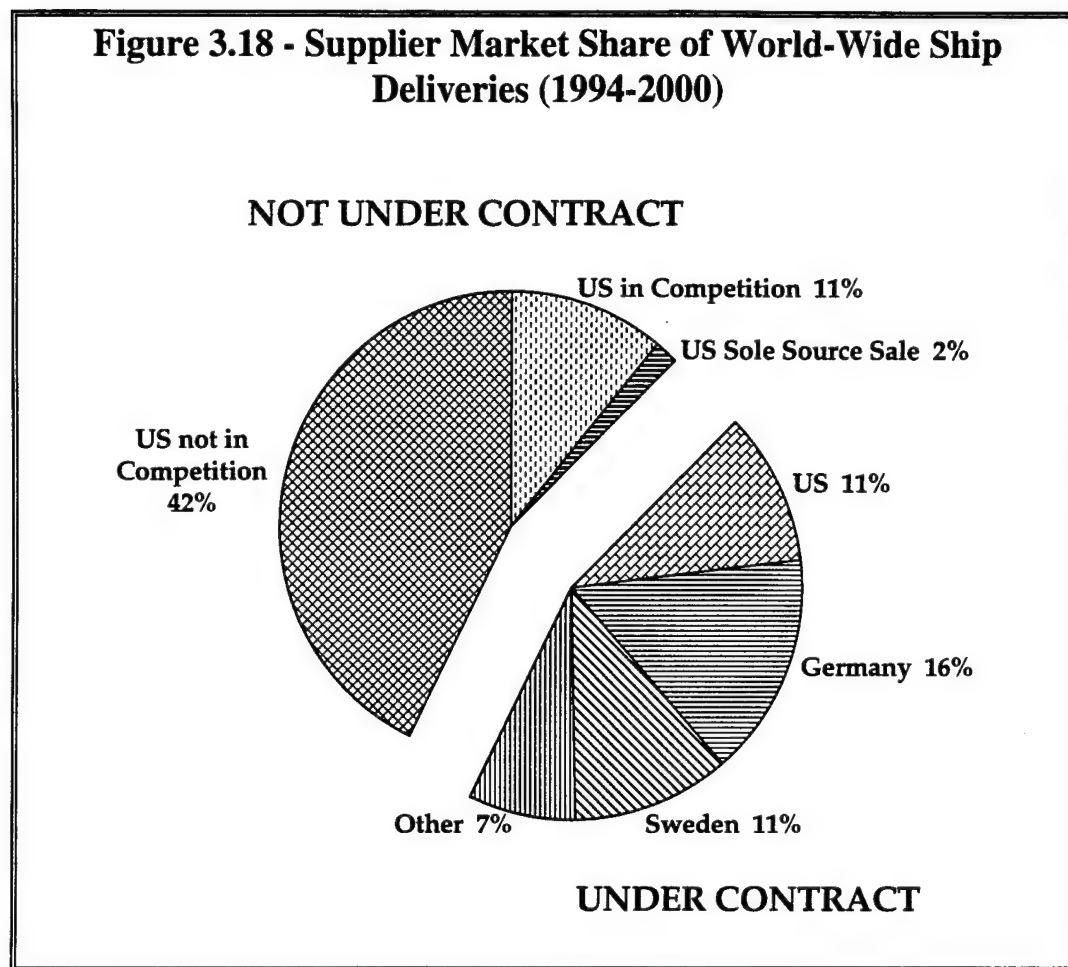
In summary, U.S. vehicle deliveries already under contract represent nearly 70 percent of the total under contract. This is the only category where U.S. export expectations from sales not yet made are substantially lower, on a percentage basis, than from existing sales. The U.S. estimated market share of deliveries not under contract ranges from 13 to 35 percent of that market segment. When contracted and not contracted sales are combined, the U.S. share is projected to vary between 39 and 50 percent of the global market. Similar conclusions are drawn from both upper and lower delivery estimates.

### **3.5.4 Ship Forecast**

Acquisitions of ships and ship upgrades for the rest of the decade are shown in Figure 3.18 on a percentage basis. The ship category includes carriers, destroyers, frigates, miscellaneous ships, and submarines. Total deliveries were valued between \$24.5 billion and \$29.7 billion in constant 1991 dollars -- about 15 percent of total ATDB revenue.

Ships are the only major arms export category not dominated by the U.S. Only 11 percent of the market is U.S. deliveries from existing contracts -- approximately 30 frigates and miscellaneous craft to a variety of customers and some Egyptian submarine upgrades at a combined value of \$3.2 billion. These deliveries place the U.S. as the third largest exporter based on existing contracts. Germany leads all suppliers with 16 percent, or \$4.6 billion, of deliveries under contract (a mixture of frigates and submarines). Sweden is second with \$3.3 billion of deliveries under existing contracts. Other suppliers with delivery contracts include the UK (\$0.9 billion), Russia (\$0.4 billion), Spain (\$0.3 billion), and China, Italy, and the Netherlands (\$0.2 billion each).

**Figure 3.18 - Supplier Market Share of World-Wide Ship Deliveries (1994-2000)**



The potential for additional U.S. exports in the portion of the ship market not yet on order is similar to contracted deliveries. The world market for military ships is relatively small but competitive. The U.S. is not a major ship exporter and will most likely retain only a limited share of this market. Although the U.S. has not been producing non-nuclear submarines for many years, on April 7, 1994, the State Department granted an export license to Ingalls Shipbuilding to allow the shipyard to continue its efforts to market and build diesel-powered submarines in the U.S. for possible export.

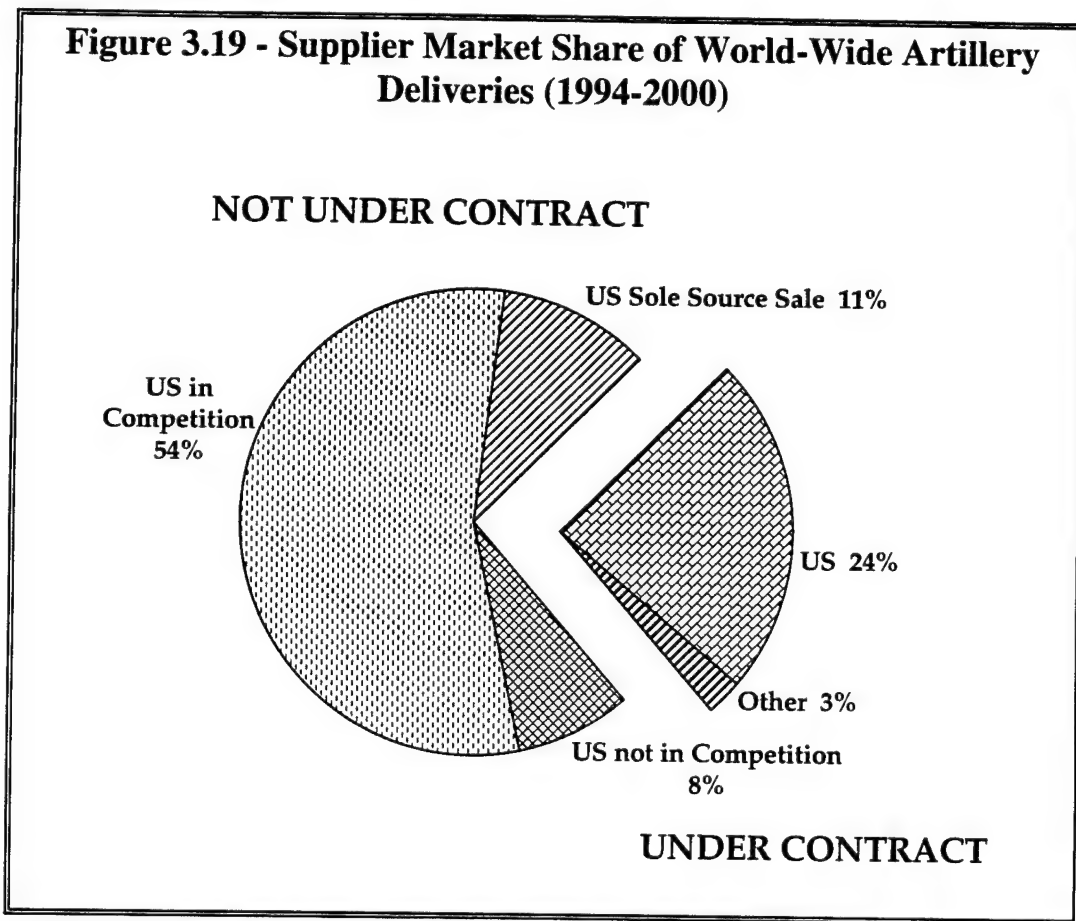
With percentages based on the total market, the U.S. is considered to be the sole source for future contracts for only two percent of the global deliveries. The U.S. is in competition for approximately 11 percent of the market, valued between \$2.5 billion and \$3.2 billion, principally for the sale of missile patrol boats to Saudi Arabia and frigates to the UAE. The U.S. is not a competitor for between \$8.5 billion and \$12.8 of deliveries from future sales agreements.

In summary, the U.S. accounts for 24 percent of ship deliveries already under contract. The U.S. share of deliveries from future contracts may range from 3 to 22 percent. In

combination, the U.S. share of global ship deliveries is projected to vary between 12 and 23 percent. Similar results may be derived from the lower bound delivery scenario.

### 3.5.5 Artillery Forecast

Global artillery systems deliveries from 1994 through 2000 are depicted in Figure 3.19 which provides a percentage breakdown of the contracted and non-contracted portions of the market. Air defense artillery, multiple rocket launch systems, and large caliber artillery systems have all been included. The size of this market, in 1991 dollars, is estimated to be between \$3.9 billion and \$7.2 billion according to the information in the ATDB. This represents about four percent of total arms trade.



The U.S. dominates this market, with \$1.7 billion in revenue from deliveries for existing contracts, representing 24 percent of the total market. In total, deliveries from existing contracts are valued at \$1.9 billion. The U.S. sells 155mm and 8-inch self-propelled howitzers and its

Multiple Launch Rocket System (MLRS) -- approximately 900 systems in total. The U.S. is also supporting an Israeli upgrade of U.S. manufactured 155mm howitzers. Other suppliers with contracts include a European 155mm howitzer consortium (\$0.1 billion) and South Africa (\$0.1 billion).

The artillery deliveries projected from future contracts are estimated to be between \$2.0 billion and \$5.3 billion. The U.S. is considered to be the sole source supplier for 15 percent of the deliveries from future contracts, valued at \$0.8 billion. The U.S. is also in competition for an additional \$0.7 billion to \$4.0 billion in artillery exports in the future. This competition includes the sale of howitzers to Kuwait and India, and MLRS to Saudi Arabia and the UAE. The U.S. is not in competition for future deliveries representing about eight percent (\$0.6 billion) of the total market. Russia and Israel have the edge in this market segment.

In summary, the U.S. will deliver 90 percent of all artillery systems already under contract. For deliveries not under contract, the U.S. share may range between 14 and 89 percent. When all deliveries are combined, the U.S. market share is projected to vary between 34 and 89 percent when the upper bound market projection is used. For the lower bound sales estimate, results are somewhat different. The total U.S. share is estimated to lie between 63 and 89 percent of the market, implying that the greatest uncertainty for the U.S. market share is generated by the low likelihood of sales by other nations.

### 3.5.6 Missile Forecast

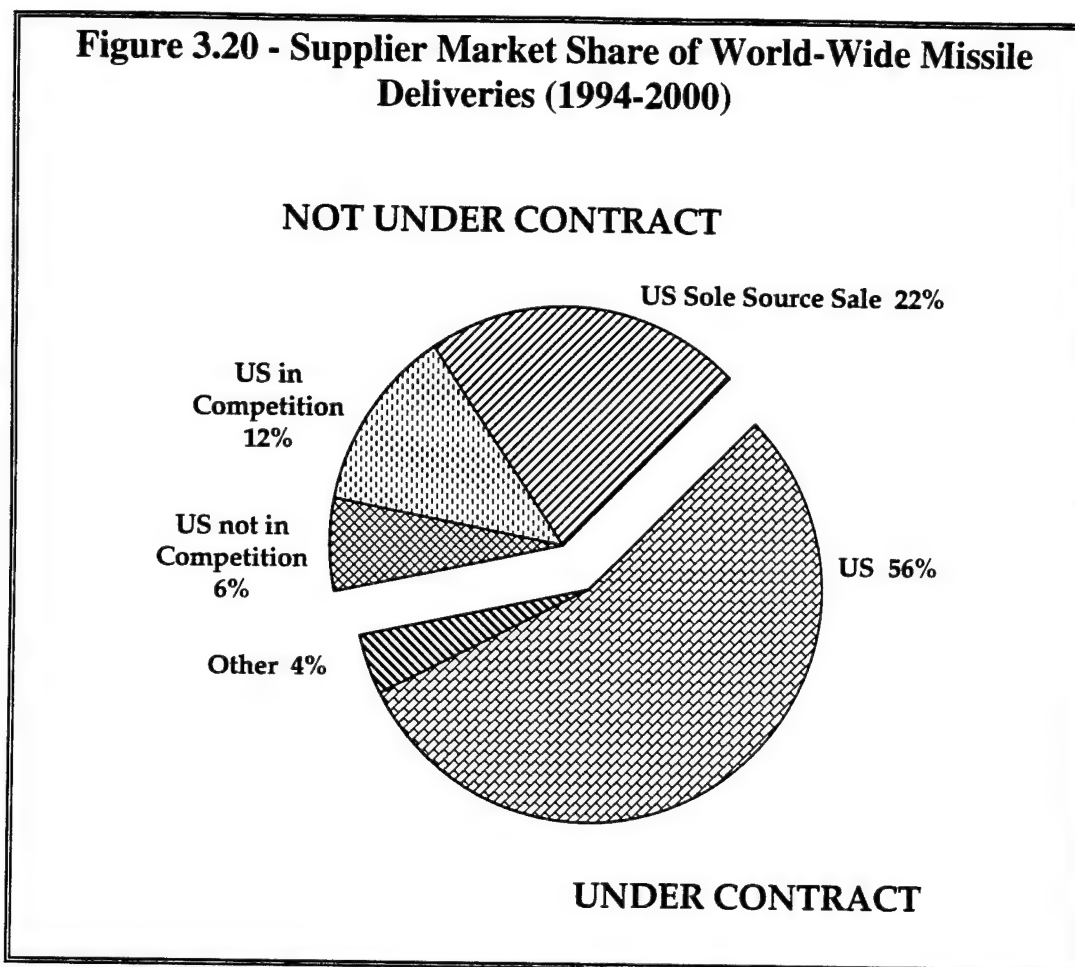
Figure 3.20 shows the percentage share of missile deliveries through the year 2000. The global missile market was subdivided into seven categories: air-to-air missiles, anti-tank guided missiles, ballistic missiles, cruise missiles, precision guided missiles, surface-to-air missiles, and torpedoes. The ATDB values these deliveries, totaling more than 15,000 individual missiles, between \$17.7 billion and \$22.1 billion, in 1991 constant dollars, accounting for approximately 11 percent of total arms exports. Most of this market consists of new sales, with a limited number of Hawk surface-to-air-missile and torpedo upgrades.

The U.S. dominates in this market. Of the \$12.9 billion to \$13.1 billion already under contract, the U.S. portion ranges between \$11.9 billion and \$12.2 billion. Other suppliers with existing contracts include North Korea (\$0.4 billion), France (\$0.3 billion), and Israel (\$0.3 billion).

The almost 9,000 potential missile deliveries not yet under contract have an estimated value between \$4.8 billion and \$9.0 billion. Twenty-two percent of deliveries from future contracts, between \$1.1 billion and \$4.8 billion, are expected to be from U.S. sole source sales. The U.S. is in competition, principally with France, Germany, and Russia, for additional contracts of between \$2.6 billion and \$2.7 billion -- 12 percent of the total missile market. The U.S. is not expected to compete for \$1.0 to \$1.4 billion in deliveries.



**Figure 3.20 - Supplier Market Share of World-Wide Missile Deliveries (1994-2000)**



In summary, the U.S. will deliver approximately 93 percent of the dollar value of missiles already under contract. The expected U.S. share of deliveries from future contracts may range between 54 and 84 percent of the high market estimate and between 24 and 78 percent of the low market estimate. This implies that the U.S. is the sole source competitor for some of the more tenuous sales. The U.S. total market share is projected to be in the 74 to 89 percent range in either case.

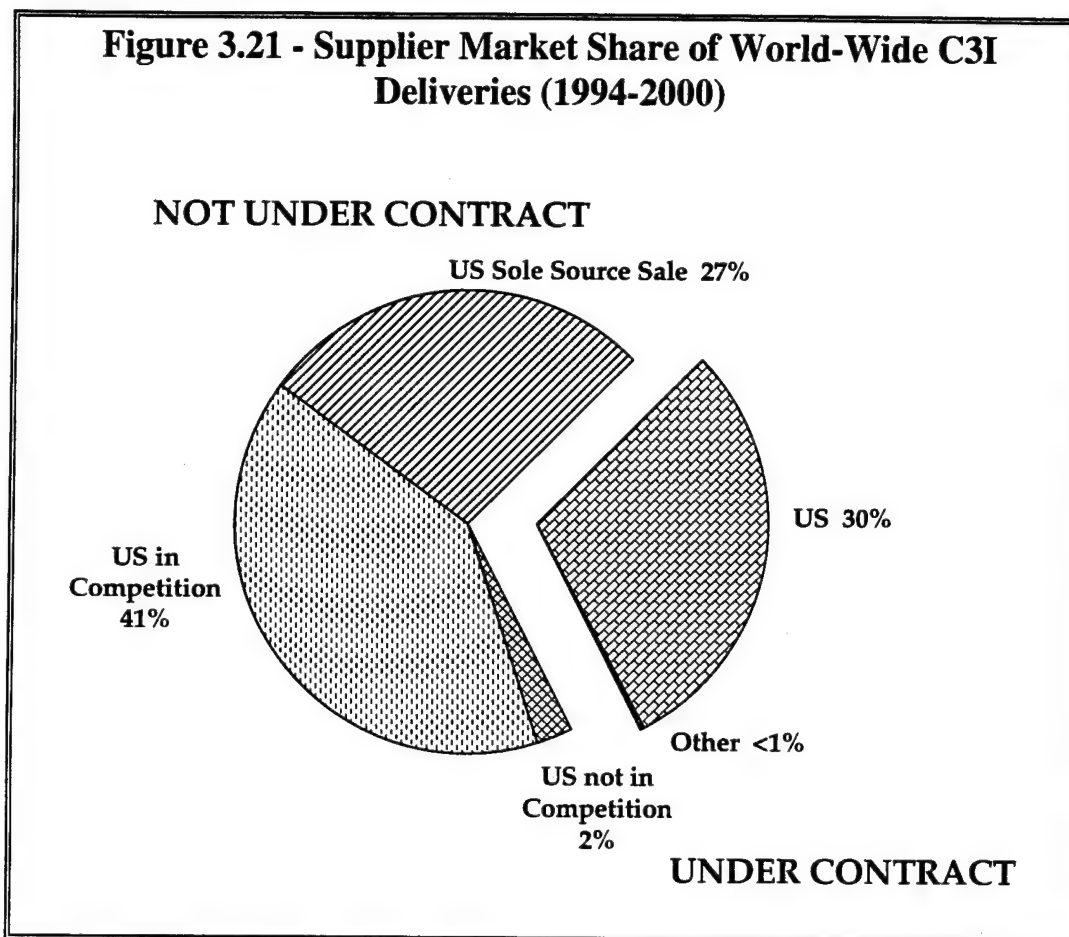
### 3.5.7 C3I Forecast

Figure 3.21 shows the percentages of the C3I market as provided by the ATDB. The C3I market export deliveries are valued between \$3.6 billion and \$3.8 billion in 1991 dollars, through the end of the decade. While this represents only two percent of world-wide arms trade, C3I



sales are an expected growth area. C3I systems or subsystems include radar, communication, and targeting systems.

Nearly all deliveries from the \$1.1 billion in existing contracts, are of U.S. origin. The value of deliveries from future contracts may range between \$2.5 billion and \$2.6 billion. The U.S. is estimated to be the sole source for \$1.0 billion of the future deliveries, or about 27 percent of the global market. The U.S. is primarily in competition with France for about 41 percent of the global market valued at \$1.3 billion to \$1.5 billion.



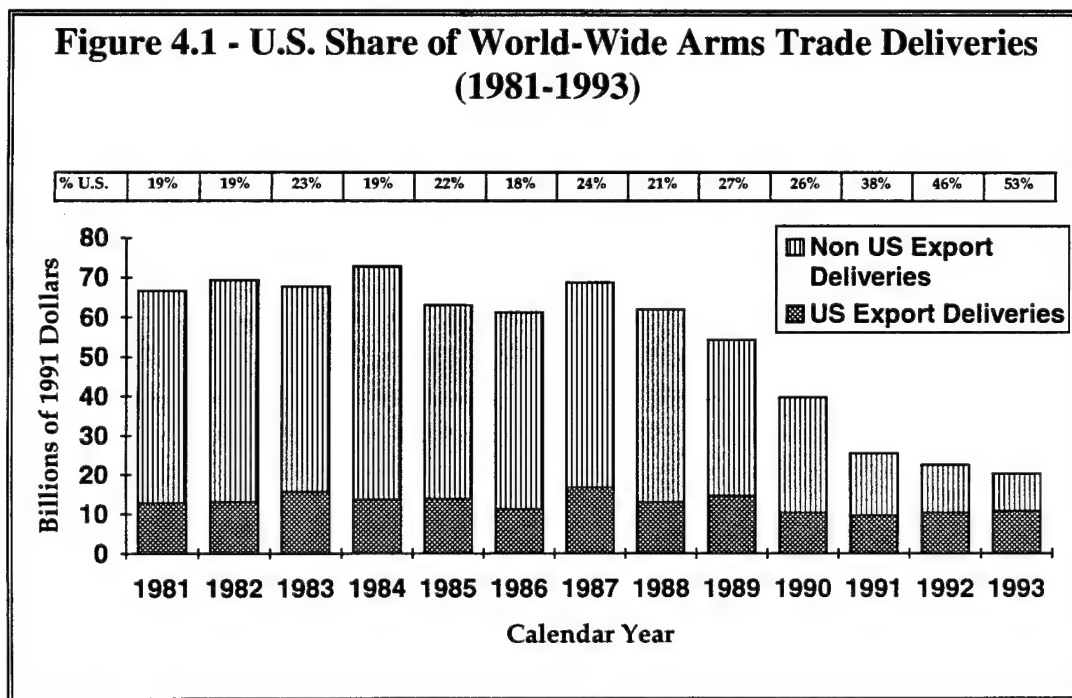
In summary, the U.S. has nearly 100 percent of the deliveries from existing contracts. For both high and low market estimates, the U.S. share of deliveries under future contracts is projected to be between 40 and 96 percent of the market. The U.S. share of all deliveries will be between 61 and 98 percent of the C3I market.

## 4. Future U.S. Export Performance and Potential Impacts of Arms Trade Policies

*Chapter 4 interprets the material presented in Chapters 2 and 3 to determine the likely bounds on the U.S. share of the arms trade market -- the second objective of this study. The analyses suggest continuing strong arms sales of U.S. products through the end of the decade and beyond, assuming that there are no dramatic changes in overall U.S. conventional arms transfer policy or in the global security environment. Section 4.1 summarizes the numerical findings from Chapter 3 and shows how changes in the level of support that the U.S. government provides to arms exports, within the overall current policy framework, would probably only lead to marginal changes in the dominant U.S. market share. Section 4.2 discusses several of the qualitative factors that will contribute to the strong U.S. market position during the forecast period.*

### 4.1 U.S. Market Share of World-Wide Arms Trade

Figure 4.1 shows the U.S. share of total world-wide arms trade deliveries from 1981-1993.



During the 1981-1988 Cold War period, world-wide arms trade deliveries averaged about \$66 billion annually in 1991 constant dollars. The U.S. share of that market averaged slightly more than 20 percent per year. In the immediate post-Cold War period, from 1989 through 1991, the size of the export market fell by more than one-third to an annual average of \$40 billion. The U.S. share of these immediate post-Cold War deliveries averaged just above 30 percent. In 1992 and 1993, world-wide arms deliveries dropped almost an additional 50 percent to an annual average of \$21 billion, with the U.S. share increasing to more than 50 percent of the market, making the U.S. defense industry the world's preeminent military equipment supplier. Over the entire 1981-1993 period, U.S. deliveries declined by less than 25 percent, from approximately \$13 billion per year to between \$10 billion and \$11 billion annually, as compared to a decline of nearly 70 percent for the total market.

The strong defense export market performance by the U.S. defense industry is consistent with overall U.S. performance. Based on data from Morgan Stanley Capital International, U.S. industry accounts for 37 percent of all global sales and 48 percent of all global profits. In the technology and performance driven aerospace and military markets, U.S. corporations are even stronger with more than four-fifths of the profits and three-quarters of the global sales<sup>11</sup>.

The ATDB data support a continuing strong arms trade performance by U.S. products through the end of the decade and beyond. An aggregation of deliveries from 1994 through 2000 shows a total market size ranging from \$172.6 billion to \$202.5 billion. The U.S. would have a minimum<sup>12</sup> of 54 percent of the lower bound and 51 percent of the upper bound of this total market through the year 2000.

This strong performance is based, in part, on \$66.4 billion to \$67.2 billion of future deliveries under existing contracts. These on-contract future deliveries account for a minimum of 63 percent of this \$102.9 billion to \$106.5 billion undelivered, on-contract market<sup>13</sup>. (See Figure 3.14.)

The strong performance is also based on deliveries from future contracts. In this \$69.5 billion to \$96.0 billion market segment, the U.S. market share could range between as little as 37 percent (from \$26.8 billion to \$35.8 billion in sole source U.S. sales)<sup>14</sup> to as much as 64 percent (from an additional \$17.5 billion to \$24.1 billion deliveries where U.S. industry faces competition)<sup>15</sup>. Deliveries from future sales will continue into the next decade, thereby extending the expected time period where the U.S. will remain the world's pre-eminent military equipment supplier.

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<sup>11</sup> Daniel Strickberger, Wall Street Journal, February 15, 1994.

<sup>12</sup> These minimums assume that the U.S. loses every competitive sale in the future.

<sup>13</sup> This minimum is derived from the upper bound forecast. The corresponding number for the lower bound forecast is 65 percent.

<sup>14</sup> This ratio is based on the upper bound forecast for U.S. sole source sales only. The lower bound result would be 39 percent.

<sup>15</sup> This ratio is based on the U.S. winning all competitive sales in the lower bound forecast. If the U.S. were to win all competitive sales in the upper bound forecast, the corresponding result would be 62 percent.

Many policy changes have been proposed in order to increase potential U.S. arms export sales. These changes focus particular attention on general measures affecting the level of government support for arms exports (such as establishment of a defense export finance facility).

Using data from the ATDB, four cases have been created to examine the potential impact on U.S. arms export market share that could result from any general shift in conventional arms transfer policy (Figure 4.2 cases A-D). Each case establishes an alternative baseline for future arms export deliveries, given the assumption that the U.S. does not make sweeping policy changes affecting the types of arms that are eligible for export to particular countries or regions.

Each case divides the estimated arms export deliveries for the remainder of the decade into four categories<sup>16</sup>.

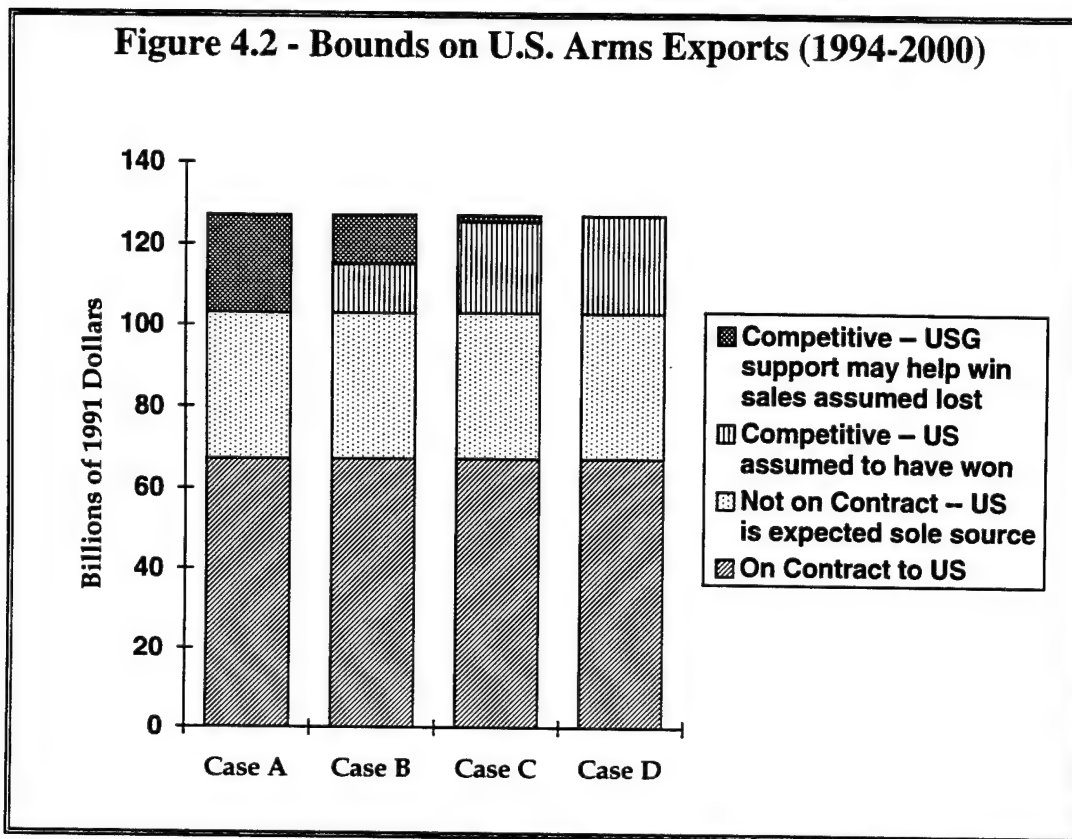
- Category 1 represents future deliveries under existing contracts.
- Category 2 represents future deliveries under future contracts where the U.S. is likely to be the sole source.
- Category 3 represents the share of the \$17.5 billion to \$24.1 billion in deliveries under future competitive sales that is won by U.S. firms.
- Category 4 represents the remaining portion of the \$17.5 billion to \$24.1 billion in deliveries under future competitive sales that U.S. firms do not win.

Since categories 1 and 2 are assured or nearly assured deliveries, the different baseline cases make different assumptions about the split in deliveries between categories 3 and 4. Together, categories 3 and 4 represent the "competitive" arms market for U.S. industry. Changes in the level of support that the U.S. provides to arms export sales can affect the amount of the market that falls within each of these two categories under each of the baseline assumptions.

In case A, the U.S. is assumed to obtain none of the additional \$24.1 billion in deliveries resulting from future competitive sales. In case B, the U.S. is assumed to win exactly 50 percent of these competitions. In case C, the division between categories 3 and 4 is set at a point such that the U.S. share of the total non-contracted market is as close as possible to the U.S. share of the current on-contract market for each of the seven commodity categories. Finally, in case D, the U.S. is assumed to capture all of the deliveries associated with future competitive sales. Figure 4.2 shows these four cases (*which always use the upper bound total market forecasts*), aggregated by commodity, for arms deliveries from 1994 to 2000.

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<sup>16</sup> The percentages for each of these categories were portrayed in Figure 3.14



Case A, where the U.S. would lose in every single arms trade competition through the end of the decade, is a highly unlikely situation. Under case A, the U.S. arms trade market share would be 48 percent through the rest of the decade (51 percent solely for the ATDB countries and commodities)<sup>17</sup>. If, instead, we were to use the lower bound estimate of future arms export deliveries, the U.S. share would be 50 percent (54 percent of the ATDB market). Therefore, under the case A scenario, the U.S. would lose approximately \$21 billion in deliveries to competition on an approximate \$98 billion sales base -- a 21 percent ratio -- which might potentially be susceptible to the effects of policy changes.

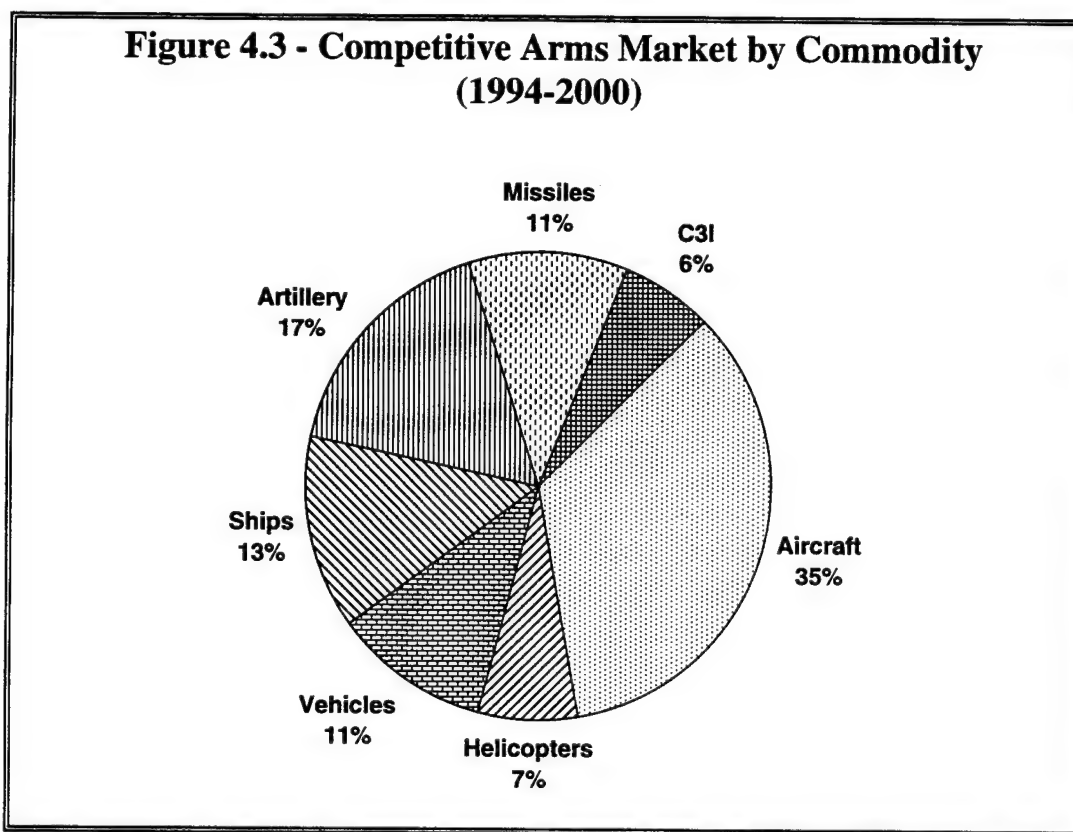
Case B arbitrarily assumes that the U.S. would win 50 percent of the contracts in which it faces competition. This represents a more reasonable base case for a forecast of U.S. sales, given recent experience. If this case were to occur, the U.S. share of the global arms market would be 53 percent through the year 2000 (57 percent of the ATDB market). With the lower bound scenario the U.S. market share would be 55 percent (59 percent of the ATDB market). Case B implies that the U.S. will lose \$9 billion to \$12 billion in deliveries to competition relative to a \$102 billion to \$115 billion base -- nine to ten percent -- which might be affected by policy changes.

<sup>17</sup> See section 3.2 for details of the methodology used to project global totals.

Case C represents continuation of the market status quo in competitive sales through the end of the century<sup>18</sup>. Under case C, the U.S. would capture nearly all of the deliveries under future competitive sales, resulting in an overall global arms market share of 58 percent (62 percent of the ATDB market). With the lower bound assumptions the U.S. market share would be 59 percent (63 percent of the ATDB market). Case C implies that the U.S. would lose only \$1 billion to \$2 billion in deliveries to competition over and above \$109 billion to \$125 billion in exports -- only one percent of the total -- susceptible to increase through policy shifts.

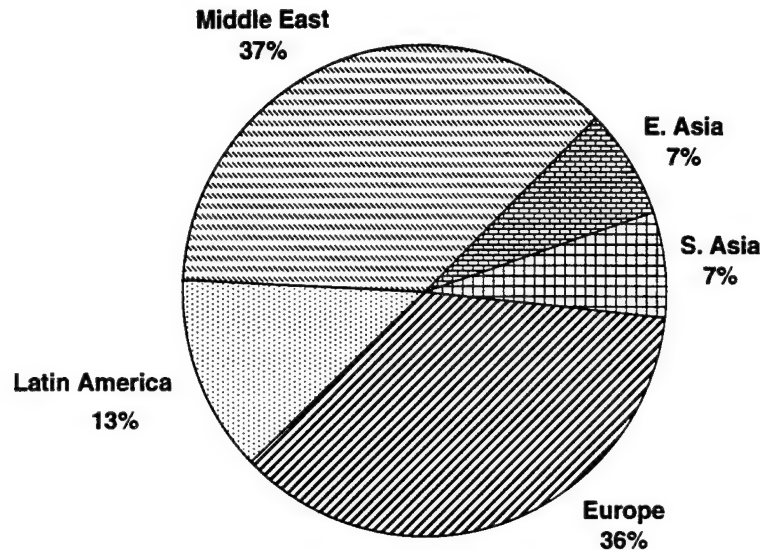
Under case D, the U.S. captures all deliveries associated with sales in which there is likely to be competition. This is clearly the upper bound of future U.S. performance. For this situation, the U.S. share would equal about 59 percent of total world-wide deliveries through the end of the decade (63 percent of ATDB deliveries), in both the upper and lower bound scenarios.

To further understand the dynamics involved in setting bounds on U.S. arms exports, the \$24.1 billion competitive arms market (categories 3 and 4) is portrayed by commodity and demand region in Figures 4.3 and 4.4 respectively.



<sup>18</sup> Case C was constructed as follows. For each commodity, individually, an attempt was made to match the U.S. percentage of all deliveries not yet under contract with the U.S. percentage of deliveries already under contract. It was assumed, that with this baseline case, the U.S. would win sufficient competitive sales to achieve this match. This was not always possible because, in some cases, the size of the sales for which the U.S. would not compete was too large. In these cases it was assumed that the U.S. would win all competitive sales, so its share of deliveries not yet under contract was as close as possible to its share of deliveries already under contract.

**Figure 4.4 - Competitive Arms Market by Demand Region  
(1994-2000)**



In the absence of changes affecting the level of support that the U.S. provides for arms exports, the U.S. share would likely fall between cases B and D -- a range of \$9 billion to \$12 billion over the forecast period or between 53 and 59 percent of the global market. To move outside this range, the U.S. would likely have to begin making broad changes in political, military, and foreign policy decisions concerning arms export approvals. Nothing in Figures 4.3 and 4.4 suggests that the U.S. is likely to lose more than 50 percent of these future sales.

Within this 53 to 59 percent range, changes in the amount of support that the government provides for approved arms exports could affect the precise U.S. share. At issue, however, is where between cases B and D the U.S. share is likely to be found, absent any changes in policy. Because the U.S. already captures most of the arms exports from sales in which the U.S. faces competition, case C implies that the U.S. will achieve 58 percent of the global market. Therefore, if case C represents the expected outcome, a reasonable projection of the potential maximum impact of increased support for arms exports is \$1 billion to \$2 billion over the forecast period, or less than \$300 million annually.

Figures 4.3 and 4.4 give some indication that increased support may have a marginally greater potential role. Figure 3.14 showed that the U.S. has 63 percent of the on-contract deliveries. Based on the data given in Section 3.5, only the ship and artillery sectors fell below that average. These weakest U.S. sales sectors, however, account for 30 percent of the \$24.1 billion competitive market, whereas they only represented 14 percent of the on-contract deliveries. In addition, Figure 4.4 shows Europe representing 36 percent of the same competitive demand, with more than one-third of this demand in the artillery sector. Some European



countries' reported intentions to increasingly buy from European sources also implies that case C may overstate the expected outcome. On the other hand, the \$1.3 billion 1994 UK order for deliveries of Lockheed C-130J transport aircraft was not captured in the ATDB, since it had been assumed that deliveries would not start until after the year 2000.

If we were to assume case B as the most likely scenario, the maximum potential impact from policies increasing U.S. market share would have been more like \$1.3 billion (from the lower bound scenario) to \$1.7 billion in additional sales annually. While it is believed that case C (worth \$300 million maximum additional sales annually) is the more likely outcome of current policies, we should recognize the possibility that this may somewhat understate the potential for U.S. sales to increase.

## **4.2 Factors Contributing to the Continued Market Strength of U.S. Arms Exports**

There are several reasons to conclude that U.S. arms exports will maintain this strong market position:

- U.S. firms enjoy a well-earned reputation for producing reliable, durable products. The business practices and infrastructure of U.S. firms have evolved in a way that fosters continuing quality improvement.
- U.S. products are characterized by high quality and performance, and are priced competitively with other western manufacturers in the market.
- Desert Storm illustrated the superiority of U.S. products in a realistic battlefield environment.
- The U.S. has invested substantially in the defense research and development that are necessary to design and produce the best performing equipment in the world, now and in the future.
- In some cases, the U.S. supplies unique equipment.
- The U.S. has built long standing customer relationships with a number of countries. Therefore, to some extent, such countries have come to depend on U.S. suppliers and would find it difficult and expensive to shift sources.
- Many countries seek interoperability with U.S. equipment because of standardization agreements and political alliances which could lead to military coalitions with U.S. forces.



- The U.S. provides outstanding service and support after the sale. Maintenance of equipment or installed systems may not only require training of host country staff but also require the presence of U.S. company personnel whose skills may be needed for a decade or more if a large-scale system is involved. The U.S. production base is also a reliable source of spare parts.
- The U.S. offers comprehensive training services, often including military simulators, which are becoming increasingly important with today's complex weapon systems.
- Major defense spending reductions by European countries may result in a less competitive European defense industry vis-a-vis the U.S.

There are also reasons why the U.S. market share will not expand significantly:

- The attitudes and policies of the host country can be specifically designed to limit market dominance by any one supplier. With the successful outcome of the Gulf War, certain Middle Eastern countries such as Kuwait and the United Arab Emirates have opted to make military purchases from different sources including the U.S., France and Russia. They apparently are attempting to solidify alliances with key countries such as those on the U.N. Security Council. By keeping their options open, these countries can avoid becoming dependent on a single source and thus avoid strategic dictates from outside their border.
- In some markets there are strong pressures to buy defense products from domestic or regional suppliers to support local defense industry.
- There are certain markets where the U.S. will not sell arms because of aggressive or terrorist policies or intentions by the potential buyer, technology transfer restrictions, the potential for illegal resale of product or technology, etc.

In summary, in most of the markets where U.S. products compete, the U.S. will maintain its predominant role for the reasons described above. Changes in the level of support that the U.S. provides to arms exports may change the U.S. arms export market share within the 53 to 59 percent range (scenarios B and D). Only as a result of changes in the basis for governmental decisions regarding the approval of U.S. arms exports would the U.S. share be likely to move outside this range. However, based on the more likely scenario (case C) for current and projected sales performance, changes in the level of support that the U.S. provides to arms exports might be expected to potentially move the U.S. arms export market share within a much narrower 58 to 59 percent range.

## 5. Conventional Arms Transfer Policy and Defense Industrial and Economic Concerns

*Chapter 5 explores how defense industrial and economic concerns might be incorporated into a U.S. conventional arms transfer policy -- the third objective of this study. It assesses the significance of the forecasted market shares in Chapter 4 relative to the ability of industry to meet DoD's requirements. Section 5.1 describes the relationship between national security and economic security and considers the industrial base contexts in which arms exports are related to economic security. While Chapter 4 concluded that the level of support the U.S. government provides to arms exports might affect U.S. market share only within a very narrow band, Section 5.2 considers the potential importance of changes in U.S. arms export sales in the context of three particular industry segments -- tanks, ammunition, and helicopters. Section 5.3 develops conclusions about the possible role of defense industrial and economic factors in a conventional arms transfer policy.*

### 5.1 National Security, Industrial Infrastructure and Arms Exports

U.S. national security policy is currently centered on addressing four dangers, as identified in the October 1993 Department of Defense Bottom-Up Review. These dangers are identified as:

- the spread of nuclear, biological, and chemical weapons;
- aggression by major regional powers or ethnic and religious conflict;
- potential failure of democratic reform in the former Soviet Union and elsewhere; and
- potential failure to sustain the robust and growing U.S. economic and industrial capabilities required for a strong defense.

The last of these four dangers is focused on the availability of the defense industrial and economic infrastructure needed to assure access to capabilities required to carry out DoD's national security missions during conflict and during peace.

With a significant level of armed conflict, the industrial infrastructure may be required to accelerate production before and during hostilities to assure, given available stocks, that required levels of defense materials are available when needed. This production acceleration principally applies to consumable items, and war reserve stockpile goals are based, in part, on the accelerated production capability of the industrial base. In addition, the industrial infrastructure must have the capability to replace items consumed during military operations to ensure the uninterrupted ability of U.S. forces to engage in potential subsequent operations. DoD uses

specific planning scenarios and analytic models to quantify these wartime requirements. In establishing war reserve stockpile goals, DoD considers both the reliability of imports and the ability of the industry to accelerate production of needed items. DoD uses the same analytic models to calculate the expected consumption rates during various contingencies and the associated production goals for post-conflict stock replenishment.

For peacetime, the industrial infrastructure is required to have the capability to develop, manufacture, and support the weapon systems and personnel needed to achieve national security objectives in a cost effective and efficient way with the minimum resources necessary to do the job. DoD defines these near and mid-term peacetime industrial infrastructure production requirements through the Future Years Defense Plan (FYDP). Longer term production requirements are based on the planned modernization and replacement of obsolete items and systems as identified in the Extended Planning Annex to the FYDP.

Arms transfers are relevant to the industrial infrastructure, and therefore to national security, to the extent that they contribute to those industrial sectors that are necessary to support U.S. national defense. Since the mid-1980s, U.S. government defense expenditures for the acquisition of services and products (especially weapon systems, munitions, and related operational and tactical support systems) has declined. Industry has responded to the decline in defense budgets by rationalizing itself to reduce excess capacities, i.e., downsizing. Companies have closed facilities, reduced employment, and consolidated and relocated operations. The defense industry has also experienced many mergers and acquisitions directly precipitated by the overall lower levels of defense spending.

In the past, DoD did not normally place much emphasis on the possible effects of defense exports on U.S. industrial infrastructure capabilities or on the cost and availability of the systems that DoD acquired. Instead, DoD broadly viewed arms trade as generally favorable to the industrial infrastructure; however, these exports were not considered as contributing to the viability of the industrial infrastructure relative to national defense requirements. This general attitude was in part due to difficulties in incorporating arms trade into planning assumptions, because arms trade involves purchasing and budgetary decisions by foreign governments that are beyond U.S. government control. It was also due in part to the minor effect of arms exports on the development cycle and the unit costs of most systems in relation to the much greater effects of DoD's purchases.

Arms trade may play an important role in the cost efficiency of certain future defense acquisitions. Arms trade can contribute to maintaining necessary industrial infrastructure capabilities. Arms trade can also be used in conjunction with DoD acquisitions to achieve economies of scale. For example, current upgrades to the M1 tank were made more affordable through foreign military sales.

The extent to which arms exports should be considered in future DoD acquisition planning is also a function of the extent to which the new threat environment affects the perceived reliability of foreign sources of supply for systems and technologies. It may be

appropriate to consider an increased role for foreign companies and international joint ventures in support of DoD requirements, including development of next generation systems.

The analysis in Chapter 4 shows that changes in the level of support that the U.S. government provides to arms exports can only marginally affect the aggregate level of U.S. arms exports. As a result, it is clear that, by themselves, changes in the level of government support for arms exports will not make a major difference in the overall financial viability of the U.S. defense industry overall. Nevertheless, it is worth exploring whether, within these margins, there may be opportunities to use arms exports to enhance national security through their effects on the cost of particular capabilities and systems. The following section considers these possible impacts.

## **5.2 Examples of Key Contributions of Arms Trade to the Industrial Base**

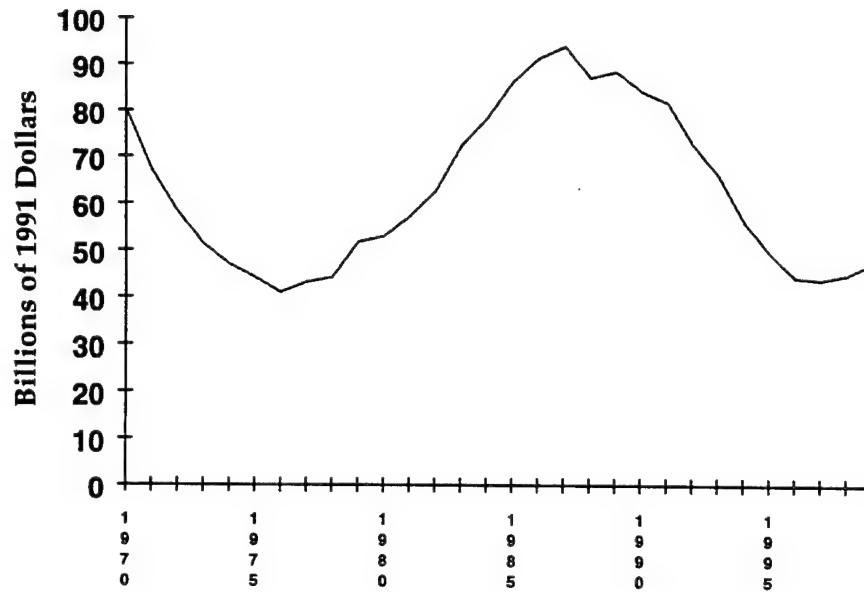
Figure 5.1 shows DoD procurement outlays in constant 1991 dollars from 1970 through 1999<sup>19</sup>. The \$80 billion outlay in 1970 was during the Vietnam War; the declining trend from 1970 to 1974 represented the U.S. withdrawal from Vietnam. From 1975 through 1978, outlays were relatively constant at an approximate \$43 billion level. A gradual increase began in 1979 and accelerated in 1981. This increasing trend lasted until a 1987 peak of \$94 billion. (Note that the peak in outlays followed a peak in appropriations by about two years.)

In Figure 5.2, U.S. arms export deliveries from 1971 through 1993 are pictured in 1991 dollars. While there are year-to-year fluctuations, there is no increasing or decreasing trend from 1971 through 1989. Exports in 14 of these 19 years ranged between \$10.6 billion and \$13.8 billion. There were three years that were unusually high -- 1973 at \$18.8 billion (attributable to the 1973 Arab-Israeli War), 1983 at \$15.7 billion, and 1987 at \$16.7 billion. Overall average exports from 1971 through 1989 were \$13.4 billion. Arms exports in every year since 1989 were below the smallest amount from 1971 to 1989. Average U.S. arms deliveries in the 1990 through 1993 time period are valued at \$10.2 billion. Based on the forecasts for the remainder of the decade however, average annual exports of \$16 billion would not be unexpected.

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<sup>19</sup> Values for 1994 through 1999 are estimates based on the 1995 DoD budget submission.

**Figure 5.1 - DoD Procurement Outlays (1970-1999)**



**Figure 5.2 - U.S. Arms Export Deliveries (1971-1993)**

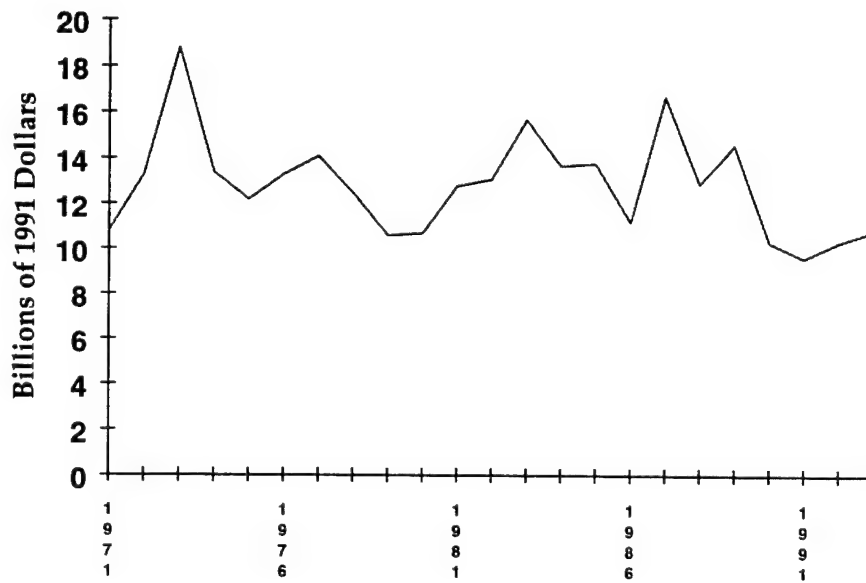
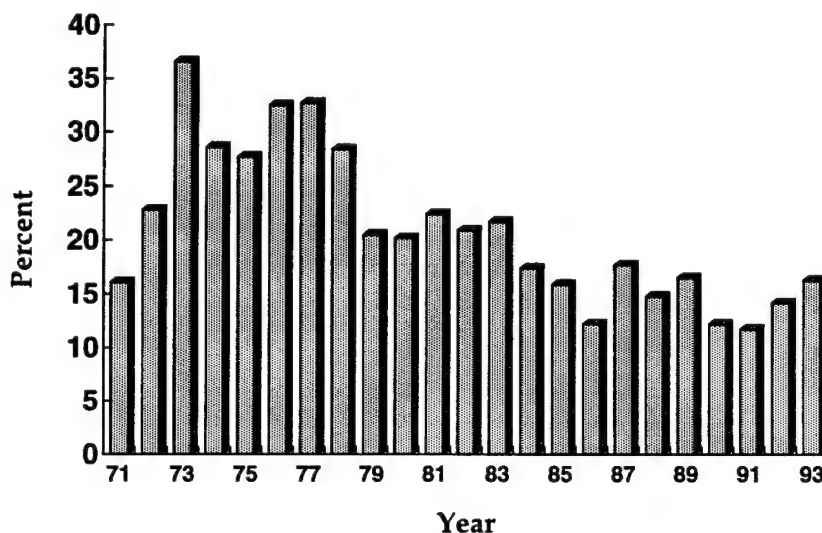


Figure 5.3 shows the ratio of U.S. arms exports (Figure 5.2) to U.S. procurement outlays (Figure 5.1) from 1971 through 1993. Some general observations can be made from Figure 5.3:

- There is an overall declining trend in the ratio from 1973 through 1993.
- This decline occurs in steps. Despite year-to-year fluctuations, there are no observable trends in the ratio from 1973 through 1978 when the ratio averaged 31.1 percent; from 1979 through 1983 when the ratio averaged 21.1 percent; and from 1984 through 1993 when the ratio averaged 14.9 percent. For this latter time period, the last two years showed consecutive increases.
- The above trend is mainly a function of changes in procurement outlays -- the effects of changing exports are secondary.

**Figure 5.3 - Ratio of U.S. Arms Exports to DoD Procurement Outlays (1971-1993)**



In summary, these data show that while arms exports have been somewhat lower during the last four years, sales agreements made in 1992 and 1993 will probably lead to export deliveries well within the range of the 19 year average prior to 1990. Despite the fact that the ratio of exports to outlays has been rising in the past three years (1991 through 1993) the ratio is still much lower than its level of the mid-1970s. However, given recent sales agreements and

projected procurement outlays, the ratio is likely to increase toward the levels of the 1970s in the future.

To gain a direct industry perspective of the contributions of military export sales on mitigating the effects of budget cutbacks on the industrial base, interviews were conducted with twelve U.S. defense firms that provide a wide range of products and services to the international military markets. Companies interviewed range from \$100 million businesses to multibillion dollar corporations. These firms included eight of the top thirteen defense contractors. They accounted for about one-quarter of the \$120 billion in defense contracts for 1992 and were responsible for an estimated 50 percent of foreign military sales.

The twelve companies produced or marketed a wide range of military items. Product lines included aircraft (fixed and rotary wing), ships, tanks, ammunition, missiles, torpedoes, and nuclear, chemical and biological warfare equipment. The firms also dealt with defense systems or sub-systems for satellites, radar, weapon control, C3I, reconnaissance, electronic countermeasures, training, simulation, and navigation.

Most of the interviewed companies indicated that even after downsizing, many production lines are expected to remain active at reduced levels of operation for the foreseeable future, depending, to some extent, on the firms' ability to increase exports. Many of the production lines targeted for shutdown are for systems that the U.S. no longer buys. However, some firms raised concerns about production slowdowns or even the closing of production lines that would eventually have to be reopened for scheduled follow-on procurements of improved systems unless export sales could bridge the gap between DoD deliveries.

Many of the firms' sales forecasts reflected the increased emphasis that they plan to place on the export markets. Several firms plan to increase exports from 10-15 percent up to 15-20 percent<sup>20</sup> of total sales in the foreseeable future. Some firms indicated that they will change their strategic focus to increase their percentage of commercial exports to help compensate for military cutbacks and foster their long term corporate viability. Three-quarters of the firms have already been involved in joint ventures with foreign firms. These arrangements typically involve firms in France, Germany, the UK, Japan, and Israel. Other participants have included companies from the Netherlands, Belgium, Norway, Sweden, Spain, Italy, Turkey, Taiwan, South Korea, Australia, and even Russia. When successful, these joint ventures provide market access while sharing risks with foreign partners.

These industry interviews, in isolation, do not indicate precise circumstances where defense needs might not be met. Consequently, additional, more detailed analyses of the Future Years Defense Plan (FYDP) data were conducted to determine how the defense acquisition cutbacks have affected specific defense industries. Based on FYDP data, the following observations have been made:

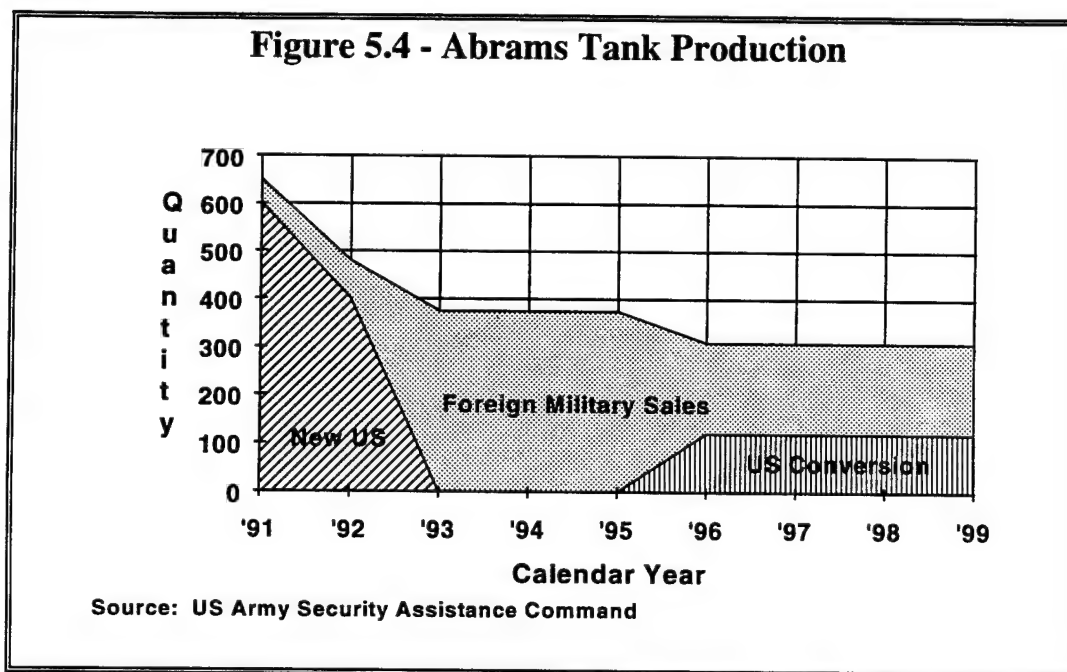
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<sup>20</sup> Some firms that are predominantly defense contractors are aiming for higher export goals that approach the 30 percent level.



- Much defense spending is consistently concentrated in a relatively small number of industries. Spending reductions will, of course, result in a contraction of these industries. However, the viability of these industries to meet defense requirements does not appear to be threatened by projected declines in defense spending. If serious problems exist for these industries, the problems are most likely to be found in subtler niches where there are only a few small suppliers<sup>21</sup>.
- Because of significant declines in DoD spending for tanks, tank components, and helicopters, arms export sales may make certain remaining acquisition programs more affordable.

In the case of tanks, export sales have helped to maintain the production base, maintain employment levels, and reduce the cost of the U.S. main battle tank conversion program. Figure 5.4 graphically shows the relative importance of export sales to the tank industry.



The existence of foreign military sales (1) provided DoD with more options in managing U.S. tank production; and (2) according to some estimates, reduced the unit cost per tank

<sup>21</sup> Industry interviews substantiated these general conclusions. To support a potential future contingency, firms cited their ability to meet DoD requirements in a situation similar to Desert Storm with capacities now available. To support DoD peacetime needs, some major companies follow DoD programs and international trends to assist their planning. Admittedly, in some cases meeting new requirements could be difficult if the labor force were dissipated and the industrial infrastructure was degraded or dismantled. It would be more difficult for small specialty or skilled manufacturers who do not have substantial resources to react to changes. With more extensive product lines, larger firms are usually better positioned to absorb the impact of program changes.

conversion by as much as one-third. The forecast suggests that foreign military sales will continue to be important to the U.S. tank production base in the future.

Apache helicopter production decreased to three units per month before scheduled production for the U.S. Army ended in 1993. Long lead procurement for the upgraded Longbow version of the Apache has been provided in FY 1995. In the interim, foreign military sales to the United Arab Emirates reduced costs to maintain the production line for procurement of Apache Longbow, scheduled to begin in FY 1996. Additional prospective foreign military sales might also reduce such costs further, but because such sales are uncertain, they cannot be relied upon for programming. While the tank and helicopter examples show the beneficial effects of foreign military sales, in some cases no foreign military sales may materialize to allow a production line to remain open to bridge a production gap.

In summary, U.S. arms exports can play a limited role in offsetting declining U.S. defense procurement budgets. Export sales can mitigate unit cost increases, raise production rates to more economical levels, provide additional revenue to U.S. producers, extend production runs, and close production gaps between a terminated system and a similar or follow-on system coming off the same production line.

### 5.3 Conclusions

U.S. decisions concerning the export of conventional arms have long been made on the basis of national security and foreign policy considerations -- defense industrial and economic considerations have not normally been factors. In our new environment, U.S. conventional arms transfer policy decisions will continue to be guided by national security and foreign policy criteria. In addition, there are certain areas in which defense industrial and economic concerns can be important secondary factors in matters of arms export policy. Of particular interest are the effects that arms exports may have on the prices that DoD pays for the systems it buys.

In the same manner, defense industrial and economic factors are also relevant with respect to the support that the government provides to approved arms exports. However, the study has shown that U.S. industry faces serious foreign competition in only a limited fraction of arms export sales opportunities, and that even then, U.S. industry often wins.

Finally, while arms exports can benefit defense industry and the economy, they cannot be a substitute for other programs to ensure the availability of the systems and capabilities that DoD needs. Arms export opportunities cannot be expected to arise simultaneously with defense industrial and economic needs. Further, the U.S. cannot allow itself to be in a position of having to approve arms exports for the sake of defense industrial and economic benefits when the national security and/or foreign policy risks are clearly too high. In the final analysis, defense industrial and economic concerns must be approached as important issues in their own right.

# **APPENDIX A**

## Appendix A. Econometric Analysis

*This appendix describes the development and results of an econometric forecast of the overall dollar value of world-wide arms trade deliveries, from 1994 through 2000, to the principal purchasing geographical regions of the world. The forecast was developed to complement the requirements-driven forecast documented in Chapter 3. Large differences between the upper and lower bounds of the econometric forecast limited the usefulness of the results in accomplishing the objectives of this study. The effects of the Cold War on the historical data probably overshadowed the effects of other influencing factors.*

*Accordingly, Appendix A is divided into three sections. Section A.1 discusses the econometric arms trade relationships developed for explaining and forecasting regional and world arms trade between the years of 1994 and 2000. Section A.2 presents arms trade forecasts for the Middle East, East Asia, and the rest of the world, based on the econometric relationships developed in section A.1. Finally, section A.3 summarizes the conclusions that may be drawn from this analysis.*

### A.1 Econometric Arms Trade Relationships

This appendix focuses on two basic questions: What are the prospects for world arms trade between 1994 and 2000? And, how does the propensity to import arms differ among the countries of the Middle East, those in East Asia, and those in the rest of the world?

World trade relationships are examined econometrically<sup>22</sup> from the perspective of the importing country. In addition, econometric techniques were applied to detailed data for the 138 countries profiled in the U.S. Arms Control and Disarmament Agency's (ACDA) World Military Expenditures and Arms Transfers (1991-1992) over the 1981-1991 period, rather than regional data aggregates for each year. There are two reasons for taking this approach.

- Econometrically, it is more straightforward to explain the demand for imports than it is to explain the supply of exports.
- The greater variation provided by the detailed data is desirable for econometric testing.

The econometric literature on international trade provides two different theories for explaining imports. For a developed country, the traditional drivers of import demand are the level of its economic activity and the ratio of domestic to import prices. According to this theory, import demand becomes higher as the country's level of economic activity increases and as its domestic prices rise relative to the prices of potential trading partners. The theory applied

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<sup>22</sup> The macroeconomic analysis contained in this report was extracted from Logistics Management Institute Report EC404RD1, June 1994 by Lawrence Schwartz and Earl R. Wingrove III.

to a less developed country uses the availability of foreign currency and the ability to pay as drivers. According to this explanation, import demand by a less developed country is constrained by its hard foreign currency holdings derived from its export earnings, grants-in-aid, loans, and foreign direct investment.

Tests<sup>23</sup>, conducted for both of these theories, found no statistical evidence that arms imports depend upon hard currency holdings or relative price considerations. Instead, the results indicated that the level of arms imports depends on the level of present and past military expenditures as well as on the presence or absence of actual hostilities during a Cold War environment. The post-Cold War is defined as the 1989-1991 period (Cold War as the 1982-1988 period), because the U.S. and the former Soviet Union reduced their military expenditures significantly beginning in 1989. The results also showed significant regional differences for the Middle East, East Asia, and the rest of the world. The estimated arms trade relationships for these three regions explain 86 percent of the variation in arms imports across the 138 countries and ten years<sup>24</sup> -- a result that provides high explanatory power.

The 16 Middle East countries are unique among the regions examined in their arms import relationships. The Cold War environment on average accounted for nearly \$1.1 billion per country (more than \$17.4 billion in total) in arms deliveries above the post-Cold War time frame. The arms import propensity for the Middle East is almost eight cents per defense dollar, significantly more than that for any other region. For example, if the Middle East spent \$65 billion on arms (the average experience in the 1980s) for ten years running, in the last year, this stream would translate into \$18 billion of arms imports.

The arms import relationship for the 18 East Asia countries differs from that for the Middle East substantially. The Cold War environment on average accounted for approximately \$710 million per country (more than \$12.7 billion in total) in arms deliveries above the post-Cold War time frame. This amount is only 65 percent of the effect of the Cold War on the Middle East. Also, East Asia's import propensity is relatively low -- only about 0.2 cents per military expenditure dollar. The effect of a steady stream of East Asia expenditures on arms imports can also be calculated. For example, if East Asia spent \$100 billion in real terms (the average experience in the 1980s) steadily over two decades, that commitment would translate into only about \$1.1 billion of real arms imports in the last year.

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<sup>23</sup> Ibid.

<sup>24</sup> Ibid. These regional trade relationships were estimated simultaneously by pooling data in the 1982-1991 time frame (1981 data were used for lagging purposes). A Koyck lagged formulation was utilized to estimate the lagged effects of military expenditures on arms imports. The military expenditure variables reflect both current and lagged levels. Lagged military expenditures are weighted by geometrically declining factors: the first-period military expenditure lag is multiplied by the weighting factor itself, the second-period military expenditure lag is multiplied by the square of the weighting factor, etc. Military expenditure coefficients for the Middle East, East Asia, and the rest of the world are, respectively, as follows: arms import propensity 0.0795486, 0.0016695, and 0.0007137; lagged weighting factors 0.71, 0.86, and 0.84. Therefore, the lagged weighting factor of .71 for the Middle East implies that it would take about ten years for the effects to dampen out. The corresponding time for the other regions is 20 years.

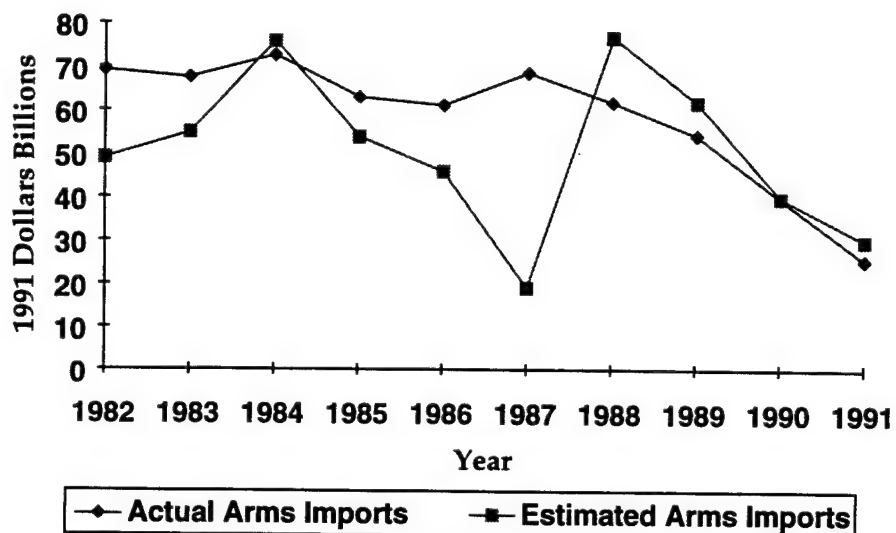
The results for the 104 countries in the Rest of the World region are similar to those for East Asia. The Cold War environment on average accounted for less than \$470 million per country (more than \$48.2 billion in total) in arms deliveries above the post-Cold War time frame. This result implies that the Cold War effect for the rest of the world is less than 45 percent of the effect in the Middle East or two-thirds of the effect in East Asia. Also, the Rest of the World's propensity to import arms is the lowest of all the regions examined -- less than one-tenth of a cent per dollar of military expenditures. Finally, if the Rest-of-the-World region steadily spent \$800 billion (in real terms) on arms (the average experience in the 1980s) over two decades, that commitment would translate into only about \$3.5 billion of arms imports in the last year.

These arms trade relationships were applied to the years between 1982 and 1991 and the results were tested to see how well they worked. Table A.1 summarizes the average absolute value of estimation errors by region over the 1982-1991 period.

<b>Table A.1 - Average Estimation Error Rates</b>		
<u>Region</u>	Estimation Error Rate (in absolute terms)	
	Billions of Dollars	Percent
World	4.8	9.3
Middle East	3.1	15.1
East Asia	0.5	7.2
Rest of the World	2.1	9.1
Note: Error rates were calculated for each year from 1982 through 1991 and averaged without reference to whether they were negative or positive in sign (absolute error rates).		

Note that the average error rates are expressed in absolute values to provide a more meaningful picture of error range. For world arms imports, the model showed a 9.3 percent average absolute estimation error rate. The estimation error rates for East Asia and the rest of the world are somewhat below the world absolute error rates, while the absolute average error rate for the Middle East is about 15 percent. Equally important, the arms import estimates for each region tracked the precipitous arms trade declines that began in 1989 very well. Figure A.1 displays the estimated and actual world arms imports between 1982 and 1991.

**Figure A.1 - World-Wide Arms Imports (1982-91): Actual vs Estimated**



## A.2 Econometric Arms Trade Projections

This section contains the results of applying the model described in section A.1 to project arms imports for the Middle East, East Asia, the Rest of the World, and the world as a whole from 1994 through the year 2000.

Two forecasting scenarios were developed for each region: (1) an upper bound forecast based upon a return to Cold War conditions or its equivalent in 1994 and a three percent annual increase in real military expenditures (a world-wide rate achieved in the early 1980s), and (2) a lower bound forecast based upon 1989-1991 post-Cold War conditions and a one percent annual reduction in real military expenditures<sup>25</sup>. These two basic scenarios were used for each region, including the Middle East which has had huge swings in real military expenditures in the 1982-1991 period.

These two widely divergent forecasting scenarios were used to take uncertainty into account. This was done in lieu of projecting point estimates and showing statistical upper and lower confidence limits around those point estimates.

<sup>25</sup> World-wide reductions in real military expenditures were more than two percent per year in the 1989-1991 period, but that rate of decline for the lower bound scenario did not seem sustainable over the long-run.



The projection equations were developed with data through 1991 only. As a result, historical projections, covering 1992 and 1993, were made first. For all regions, the lower bound scenario was used.

Figure A.2 presents upper and lower bound forecasts for Middle East arms imports. Under 1989-1991 post-Cold War conditions, the lower bound arms import projections for the Middle East show a decline from a \$15 billion peak in 1989-90 to \$10 billion by the year 2000. In contrast, the upper bound continuation of the region's Cold War environment or its equivalent could increase Middle East real arms imports to more than \$29 billion by the year 2000.

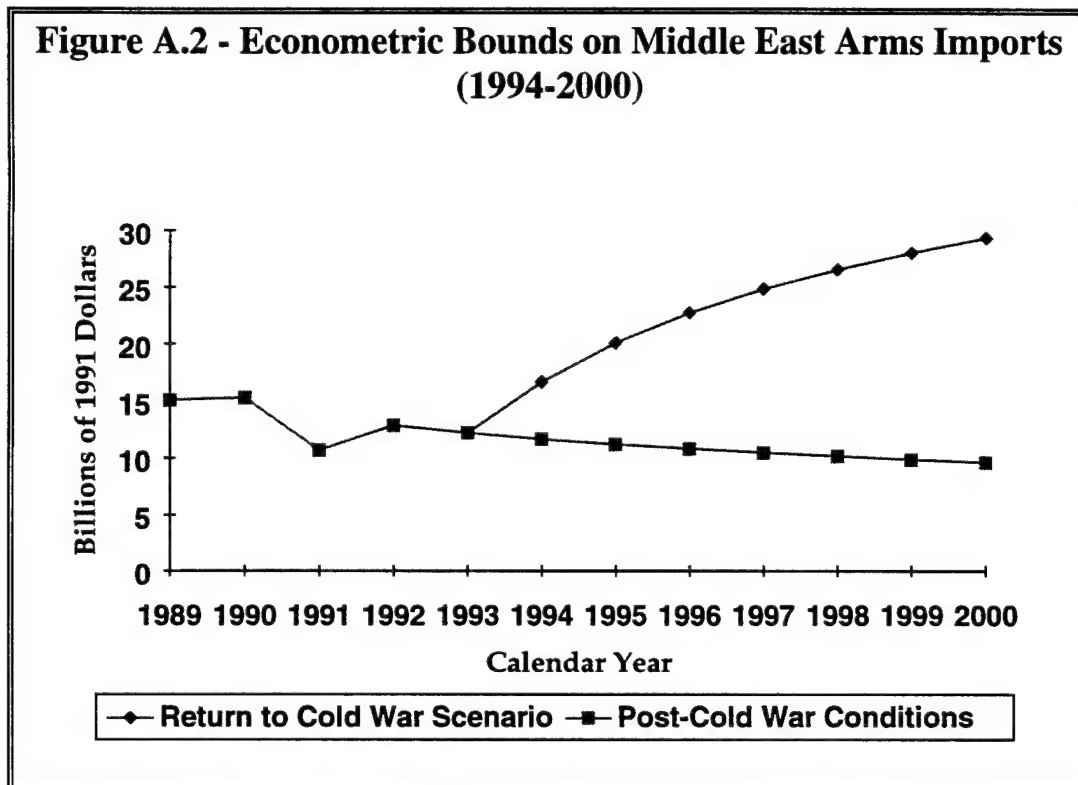


Figure A.3 displays upper and lower bound forecasts for East Asia arms imports. East Asia's arms imports could disappear by the year 1996 under the lower bound assumptions. In contrast, the resumption of the Cold War environment would increase East Asian arms imports to \$6.4 billion in real terms, almost restoring the level achieved in 1989.

**Figure A.3 - Econometric Bounds on East Asia Arms Imports  
(1994-2000)**

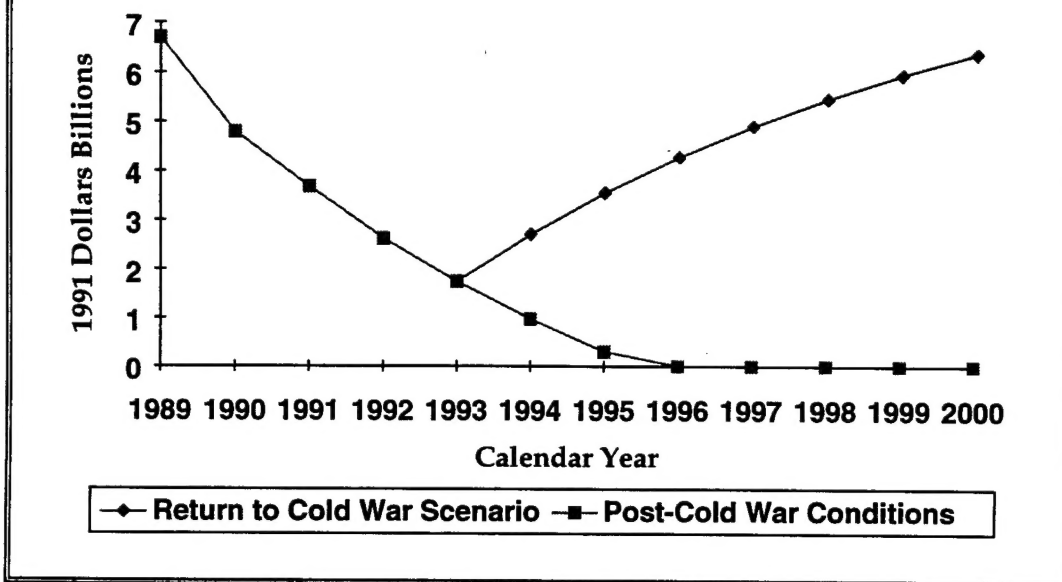
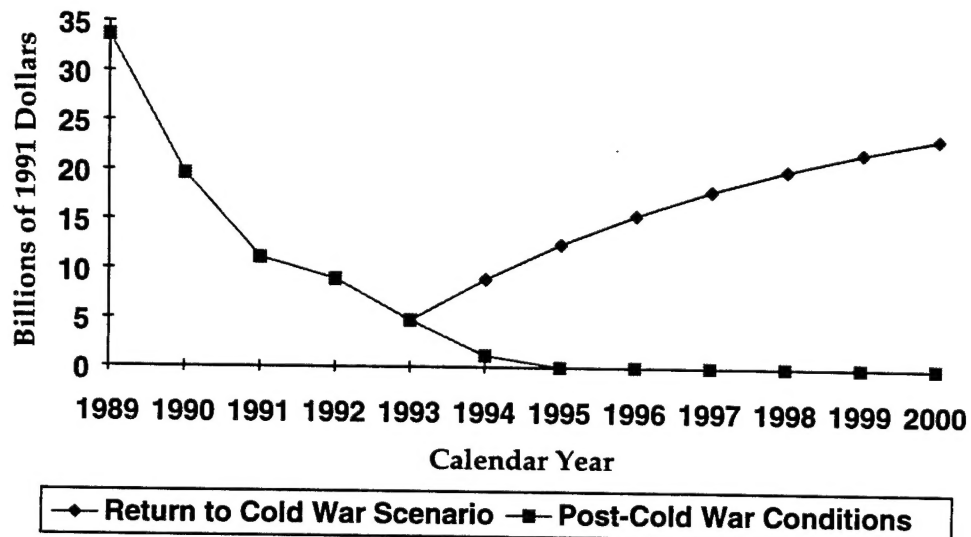


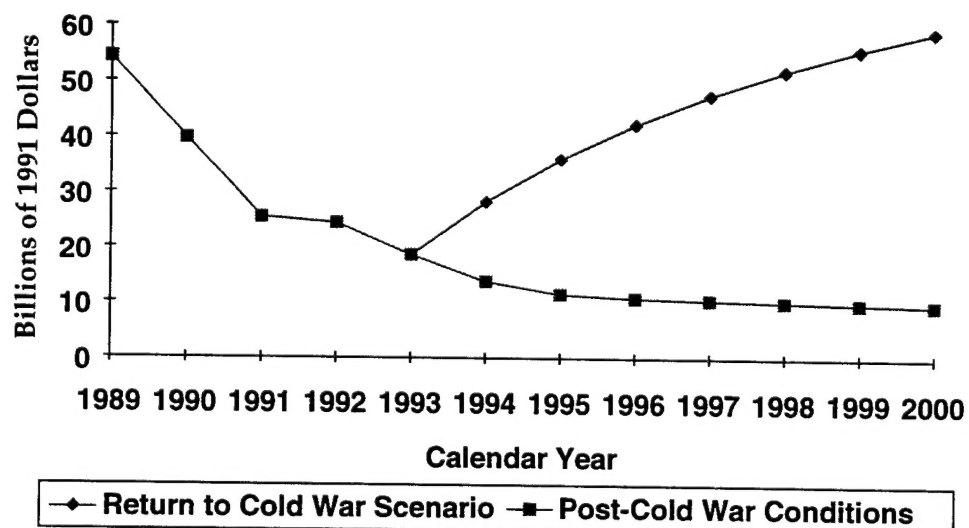
Figure A.4 shows upper and lower bound projections for arms imports in the Rest of the World. The results show that the 104 countries could be importing as much as \$23 billion annually in arms (in constant 1991 dollars) by the year 2000 under Cold War conditions or their equivalent -- \$9.5 billion less than 1989 imports. In contrast, the Rest of the World would import nothing by the year 1995 under 1989-1991 post-Cold War conditions.

Figure A.5 displays upper and lower bound world-wide forecasts of arms imports. These world arms forecasts are summations of the regional arms import projections that have been presented for the Middle East, East Asia, and the rest of the world. The projections for 1992 and 1993 continue the downward spiral at \$24.5 and \$18.7 billion respectively. As a partial check on these projections, actual data have been made available in aggregate world-wide totals. The corresponding values, \$22.5 billion and \$20.3 billion respectively, represent fairly close agreement with the projections.

**Figure A.4 - Econometric Bounds on Rest of the World Arms Imports (1994-2000)**



**Figure A.5 - Econometric Bounds on World-Wide Arms Imports (1994-2000)**



World arms imports could level off in the year 2000 to as little as \$10 billion in constant 1991 dollars, continuing the decline begun in the 1989-1991 post-Cold War period. In contrast, real world arms imports could go as high as \$59 billion by the year 2000, assuming a return to the Cold War scenario or its equivalent -- a level last recorded in 1989 but still well below the \$73 billion peak posted in 1984.

### **A.3 Summary and Conclusions**

World arms trade has plummeted as the U.S. and the former Soviet Union reduced their military expenditures significantly beginning in 1989. By 1991, the last year of ACDA published data, world arms imports stood at \$25.6 billion -- down by more than half from the \$53 billion level (in constant 1991 dollars) recorded in 1989. 1992 and 1993 aggregate world-wide totals showed the downward trend continuing, but beginning to level off with total arms trade amounts of \$22.5 billion and \$20.3 billion, respectively.

An econometric model was developed to show that arms imports depend upon current and lagged military expenditures and upon the presence or absence of a Cold War environment. These two factors explain 86 percent of the variation in arms imports across 138 countries over the 1982-1991 period. When aggregated to world-wide totals over the 1982-1991 period, the model estimates arms imports with a nine percent absolute error rate and tracks changes in direction very well.

Two scenarios were developed to forecast bounds on arms trade for the 1994-2000 period. The upper bound scenario assumed a return to a Cold War environment and a three percent annual growth in defense spending. The lower bound scenario maintained the current post-Cold War situation and used a one percent annual rate of decline in military spending. The lower bound projections for 1992 and 1993 are, respectively, nine percent higher and eight percent lower than actual totals. Depending on the scenario, world arms sales were forecast to be between \$10 billion and \$59 billion (in constant 1991 dollars) by the year 2000. The Middle East is estimated to be the largest customer.

The wide bounds on the forecast unfortunately do not allow very specific conclusions about regional arms trade. The zero lower bounds for the Rest of the World and East Asia are not helpful. Common sense expectations about arms imports would require the Rest of the World to import some arms through the year 2000, perhaps on the order of \$4 billion in real terms. East Asia probably will represent an important world arms market by the year 2000, equaling or perhaps exceeding the upper bound forecasts. For example, South Korea hopes to offset North Korea's numerical advantage in weaponry; Taiwan is attempting to convince Western suppliers to sell it more weapons; and Australia is moving ahead with a frigate and submarine program to protect its northern and western borders. Middle East security questions undoubtedly will determine whether the region's arms imports are as little as \$10 billion or as much as \$29 billion in constant 1991 dollars by the year 2000.

The effects of the Cold War on the historical data probably overshadowed the variation caused by other factors, which may come into greater play in the future<sup>26</sup>. There may even be new effects occurring as a result of different threat perceptions, the preference for upgrades, and the intense competition in the market. While the declining world-wide deliveries in FY 1992 and FY 1993 are predicted, the \$14.7 billion in U.S. arms sales agreements in FY 1992 and the \$33.2 billion in agreements in FY 1993 are not forecasted. Deliveries based on these two U.S. amounts alone may be as high as \$15 billion in FY 1994. The Rest of the World will contribute at least \$5 billion more.

Therefore, in conclusion, this econometric approach to make unclassified projections that could potentially be used by industry and the public for marketing and information for the rest of the decade, did not succeed. Heavier reliance must be placed on the forecasts derived from requirements-driven assessments.

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<sup>26</sup> Some sensitivity analysis was conducted to see the effect of defense spending changes in the range of a one percent decline to a three percent increase. The changes were minor.